

OMEGA SMALL VOLUME GROUP

FIELD SAMPLING PLAN

OMEGA CHEMICAL OPERABLE
UNIT 2, WHITTIER, CA

EPA Site ID#09BC
Docket No. 9-2004-004



Infrastructure, buildings, environment, communications



Infrastructure, buildings, environment, communications

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From:
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Date:
January 18, 2005

Subject:
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California, EPA Site ID#09BC,
Docket No. 9-2004-004

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3	1/18/05			Final Quality Assurance Project Plan - Omega Chemical Operable Unit 2, Whittier, California, EPA Site ID#09BC, Docket No. 9-2004-004, prepared for Omega Small Volume Group	
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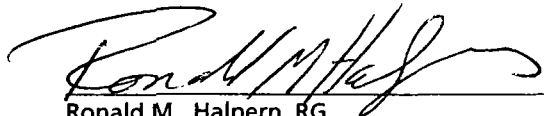
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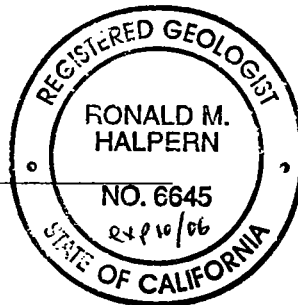
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Field Sampling Plan

Omega Chemical Operable
Unit 2, Whittier, CA

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Field Sampling Plan

Omega Chemical
Operable Unit 2,
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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY REGION IX

Plan Title Field Sampling Plan Omega Chemical Superfund Site
Operable Unit 2

Site Name: Omega Chemical Superfund Site

Site Location: Whittier

City/State/Zip: Los Angeles County, California

Site EPA ID#: 09BC

Anticipated Sampling Dates 2004 to 2005

Prepared By: Ronald Halpern, R.G.

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Field Sampling Plan

Omega Chemical
Operable Unit 2,
Whittier, CA

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Executive Summary

The Omega Chemical Corporation (Omega) is a former refrigerant/solvent recycling operation located in Whittier, California. The facility operated as a Resource Conservation and Recovery Act (RCRA) solvent and refrigerant recycling and treatment facility from approximately 1976 to 1991, handling primarily chlorinated hydrocarbons and chlorofluorocarbons. In August 1993, the United States Environmental Protection Agency (EPA) conducted a Site Assessment at the request of the California EPA, Department of Toxic Substances Control (DTSC). During this assessment, drums of unprocessed hazardous waste were observed at the site. In January 1995, the EPA conducted a second Site Assessment at the request of DTSC and observed drums in various stages of deterioration, including some that were corroded and leaking (EPA 1995a). Leaking substances were observed by EPA to be migrating to other portions of the site and off site. In May 1995, a time-critical Removal Action Memorandum was signed authorizing a removal action to address the issues of the corroding and leaking drums. The EPA then issued a Unilateral Administrative Order (UAO 95-15) to potentially responsible parties (PRPs) to perform work described by the action memorandum. The UAO was amended on August 31, 1995, to include additional PRPs. Some of the parties named in the UAO established a group identified as the Omega PRP Organized Group (OPOG).

Due to releases of hazardous substances into soil and groundwater, the EPA placed the site on the National Priorities list (NPL) on January 19, 1999. In April 1999, the EPA issued a Special Notice to OPOG members and commenced negotiations of a Partial Consent Decree requiring response work including non-time-critical removal action and remedial investigation/feasibility study (RI/FS) addressing soils located at or near the site facility. In February 2001, many OPOG members signed the Partial Consent Decree (EPA, 2001).

In January 2004, the EPA issued a Unilateral Administrative Order (UAO 9-2004-0004; the 2004 UAO or UAO) to certain PRPs that had not signed the Partial Consent Decree to perform RI/FS work. The 2004 UAO was amended in June 2004 (First Amended UAO). Fifteen of the parties named in the First Amended UAO, known as the Omega Small Volume Group (OSVOG), retained ARCADIS to perform consultant (and field) services to comply with the First Amended UAO. The Statement of Work attached to the First Amended UAO include the installation and sampling of 11 groundwater monitoring wells in the Omega Chemical Operable Unit 2 (OU-2), to assist in defining the vertical and lateral extent of contamination in groundwater downgradient of the former Omega facility.

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This Field Sampling Plan (FSP) was prepared in response to the UAO and is in general accordance with EPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA (EPA, 1988)*.

1. Objectives

This Field Sampling Plan (FSP) has been prepared to support the Omega Small Volume Group (OSVOG) in conducting a remedial investigation (RI) for the Omega Chemical Superfund Site Operable Unit 2 (OU-2) in accordance with the United States Environmental Protection Agency's (EPA) First Amended Unilateral Administrative Order (First Amended UAO) for Response Action (EPA Region IX, CERCLA Docket No. 9-2004-0004). A FSP prepared by CH2M Hill (2004) was the source for much of the text of this document. This FSP was developed in accordance with EPA Region IX, *Guidance for Preparation of a U.S. EPA Region IX, Field Sampling Plan for EPA-Lead Superfund Projects* (EPA, 1993). A Quality Assurance Project Plan (QAPP) has been prepared as a companion document to the FSP (ARCADIS, 2004b).

1.1 Background

The Omega Chemical Corporation (Omega) is a former refrigerant/solvent recycling operation located in Whittier, California, a community of approximately 85,000 people (Figure 1-1). The facility is located in the vicinity of residential neighborhoods and within 1 mile of several schools, including three elementary schools and two high schools. The facility operated as a Resource Conservation and Recovery Act (RCRA) solvent and refrigerant recycling and treatment facility from approximately 1976 to 1991, handling primarily chlorinated hydrocarbons and chlorofluorocarbons. Drums and bulk loads of waste solvents and chemicals from various industrial activities were sent to the Omega facility for processing to form commercial products. Chemical, thermal, and physical treatment processes were reportedly used to recycle the waste materials. Wastes generated from these treatments and recycling activities included distillation column (still) bottoms, aqueous fractions, and nonrecoverable solvents. Additional data regarding site history and past investigations and remediation activities are discussed in detail in the *Final On-Site Soils Remedial Investigation/Feasibility (RI/FS) Study Work Plan* (Camp Dresser & McKee [CDM], 2003a) and the *Omega Chemical Superfund Site, Whittier, California, Phase 2 Groundwater Characterization Study Report* (Weston Solutions, Inc. [Weston], 2003).

Chlorinated hydrocarbons (perchloroethylene [PCE], trichloroethene [TCE], 1,1-dichloroethene [1,1-DCE], cis-1,2-dichloroethene [cis-1,2-DCE], and chloroform) and chlorofluorocarbons (trichlorofluoromethane [Freon 11] and trichlorotrifluoroethane [Freon 113]) were identified as the primary chemicals of concern in soil and groundwater directly beneath the site. Elevated total chromium also was reported in groundwater beneath the Omega site. Elevated concentrations of chemicals of concern

were also reported in groundwater west and southwest of the Omega facility, suggesting that a downgradient migration of the contaminant plume from the site has occurred. Weston (2003) indicates the possible presence of at least six other potential sources for chlorinated compounds in groundwater downgradient of the Omega site.

EPA has divided the Omega Chemical Superfund Site into two Operable Units: OU-1 and OU-2. OU-1 includes the former Omega Chemical Facility property and extends a short distance west-southwest approximately to Putnam Street (Weston, 2003). OU-2 surrounds the Omega Chemical Facility and extends offsite approximately 2 miles to the southwest. Figures 2-2 through 2-5 show the approximate lateral extent of the plume. The exact geographical extent of OU-1 and OU-2 has not been defined. OU-1 encompasses what is considered a "source area" at the former Omega Chemical Facility property. OU-2 includes contamination in groundwater that has originated from the former Omega Chemical Facility property and potentially also from other sites. The potential other source areas are also part of OU-2. One of the goals of this investigation is to find the lateral extent of OU-2.

1.2 Objectives

The scope of this FSP is to perform fieldwork associated with the OU-2 RI. As stated in the ARCADIS' Work Plan (ARCADIS, 2004a), the overall objective of the field investigation tasked to OSVOG under the UAO is to collect data needed to fulfill the following Work Plan goals:

- Evaluate the vertical and lateral extent of contamination and the subsurface hydrogeology within and at the leading edge (south and southwestern edge) of the OU-2 contaminant plume. Approximately 11 monitoring wells or well clusters (one to three wells at each location) and one extraction well will be installed as part of this investigation in accordance with the First Amended UAO.
- Perform one round of groundwater monitoring of the 11 new monitoring wells in accordance with the First Amended UAO.

Additional investigation of potential source areas within OU-2, other than the Omega Chemical Facility, will be conducted by EPA, as necessary, when information on these areas becomes available. This FSP describes the field activities associated with the installation of 11 groundwater monitoring wells and one extraction well and monitoring of these new wells.

2. Site Background

2.1 Location and Topography

The Omega Chemical Facility is located at 12504 and 12512 East Whittier Boulevard in the City of Whittier, Los Angeles County, California (Figure 1-1). The City of Santa Fe Springs is located southwest of the Site (southwest of Slauson Avenue and east of Chetle Avenue). The community of Los Nietos is included within the City of Santa Fe Springs, northeast of Los Nietos Road. Unincorporated County of Los Angeles land is located northwest of the Site.

The Omega Chemical Facility is located along the base of the La Habra piedmont slope descending from the southwestern flank of the Puente Hills, at an elevation of approximately 220 feet above mean sea level (msl) (Weston, 2003). The piedmont slope descends toward the southwest at a slope of approximately 2.5 percent to a point approximately 2,800 feet southwest of the Omega Chemical Facility. At this point, the ground surface flattens into a broad basin or plain, at an elevation of approximately 150 to 155 feet msl. In the southwestern part of the study area, the ground surface ascends a low rise at the northwest end of the Santa Fe Springs plain, at an approximate elevation of 160 feet msl (Weston, 2003). The site and surrounding areas are completely developed. The Sorenson Avenue drain, shown on Figure 1-1, is a small concrete-lined drainage channel that flows southeast from the intersection of Dice Road and Slauson Avenue and becomes La Canada Verde Creek to the south of the OU-2 study area (Weston, 2003).

2.2 EPA Activities in the OU-2 Area

Data obtained in 1988 from site assessment activities, including groundwater and soil sampling conducted by the site owner/operator, Dennis O'Meara, and data from a preliminary assessment conducted by EPA in January 1995 (EPA, 1995a), indicated the presence of hazardous substances in subsurface soil and groundwater at the site, including methylene chloride, PCE, and TCE. The presence of these substances and deteriorated underground storage tanks at Omega led EPA to determine that an imminent and substantial endangerment requiring a removal action existed at the Omega Site.

On May 9, 1995, EPA issued a Unilateral Administrative Order to approximately 170 major generator potentially responsible parties (PRPs), all of whom sent 10 tons or greater of hazardous materials to the Site, to perform removal activities at the site

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(EPA, 1995b). These major contributing parties thereafter formed a workgroup called the Omega Chemical Site PRP Organized Group or "OPOG". The removal actions included:

- Securing the site
- Sampling and categorizing hazardous materials
- Removing hazardous substances and grossly contaminated equipment, structures, and debris
- Sampling surface and subsurface soils and groundwater to determine the nature and extent of contamination
- Disposing, stabilizing or treating grossly contaminated soils
- Grading, capping, and fencing contaminated soil areas

As part of the OU-1 effort, EPA entered into a Partial Consent Decree with the PRPs who had agreed to perform work at the site (OPOG). This Partial Consent Decree was entered into the District Court on February 23, 2001. OPOG agreed to perform an RI, conduct a Non-Time Critical Removal Action, perform a risk assessment, and install groundwater monitoring wells at OU-1, also referred to as the Phase 1A area.

In January 2004, the EPA issued another Unilateral Administrative Order (UAO 9-2004-0004; the 2004 UAO) to certain PRPs that had not signed the Partial Consent Decree to perform RI/FS work. The 2004 UAO was amended in June 2004 (First Amended UAO). Fifteen of the parties named in the First Amended UAO, known as the Omega Small Volume Organized Group (OSVOG), retained ARCADIS to perform consultant (and field) services to comply with the First Amended UAO.

2.3 Hydrogeology

This section summarizes the site regional hydrogeological setting and site-specific hydrogeologic conditions.

2.3.1 Regional Hydrogeology

The following information on regional hydrogeological setting is largely based on the California Department of Water Resources (CDWR) Bulletin 104 (1961).

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The site is located in the Central Basin of the Coastal Plain of Los Angeles County. The Coastal Plain is bounded on the west and south by the Pacific Ocean and by mountains on the north, east, and southeast. The Coastal Plain is underlain by an extensive groundwater basin in Los Angeles and Orange Counties.

Water-bearing sediments identified in the Whittier area extend to an approximate depth of at least 1,000 feet below ground surface (bgs). The identified geologic units consist of Recent alluvium, the upper Pleistocene Lakewood Formation and the lower Pleistocene San Pedro Formation. Figure 2-1 shows a generalized stratigraphic column of water-bearing sediments in the Whittier area. The Pliocene and Miocene marine sediments below the San Pedro Formation generally contain saline water in the Whittier area, although locally can contain fresh water. These units are considered non-water-bearing where exposed in the Puente Hills and include the Pliocene Pico and Repetto Formations and the Upper Miocene Puente Formation.

The major geologic structures in the area include a homocline that underlies the La Habra piedmont slope, the northwest-trending La Habra syncline underlying the alluvial basin, and the west-northwest trending Santa Fe Springs anticline situated below the slightly uplifted Santa Fe Springs plain. The La Habra syncline affects the San Pedro Formation and, to a lesser extent, the Lakewood Formation, and has a surface expression as the axis of the basin. The Santa Fe Springs anticline folds both the San Pedro and Lakewood Formations; shallow aquifers thin across the crest of the anticline. The west-northwest trending Whittier fault is located northeast of the site in the Puente Hills (CDWR, 1961).

As reported by CDWR (1961), the uppermost unit in the vicinity of the Omega site consists of the "Bellflower Aquiclude." The Bellflower Aquiclude comprises all the fine-grained sediments that extend from the ground surface down to the first aquifer. The Bellflower Aquiclude consists primarily of clay and sandy clay to silt, and ranges from 20 to more than 40 feet in thickness in this area. CDWR (1961) considers the Bellflower Aquiclude to be present in both the recent alluvium and the upper part of the Lakewood Formation. In the Whittier area, the Bellflower Aquiclude is considered to be entirely within the Lakewood Formation. Water-bearing zones locally occurring within the Bellflower Aquiclude are referred to collectively and informally as the Semi-perched Aquifer.

The Lakewood Formation consists of non-marine deposits of Late Pleistocene age and attains a maximum thickness of 70 feet. The Gage Aquifer is the major water-bearing member and comprises the basal lithologic unit of the Lakewood Formation. It consists of about 30 feet of sand with some interbedded clay. Based on previous investigations at the Omega site, the Gage Aquifer appears to be absent beneath the site proper. A sand interval found in exploratory borings a short distance southwest of the site is believed to correlate with the Gage Aquifer (England and Hargis, 1996). The Gage Aquifer is interpreted by CDWR (1961) to extend eastward approximately 2.5 miles south of the site. However, exploratory borings suggest the Gage is present west of the Omega site, but pinches out or disappears toward the east. The Gage Aquifer does not appear to be an important source of drinking water in the Whittier area, based on elevated total dissolved solids (TDS) concentrations observed during sampling, and none of the local water supply wells produce water from this aquifer.

Underlying the Lakewood Formation are primarily marine sand and gravels with inter-bedded clay, assigned to the San Pedro Formation. The San Pedro Formation reaches a maximum thickness of 850 feet and extends to a depth of about 920 feet. The San Pedro Formation unconformably underlies the Lakewood Formation. The San Pedro Formation has been subdivided into five named aquifers separated by clay members. A fine-grained layer is also typically present at the top of the sequence, although in localized areas, the uppermost San Pedro Formation aquifer may be merged with the overlying aquifer, and one or more of the five aquifers may also be merged (CDWR, 1961). This suggests that the Gage sand unit could directly overlie, and be in hydraulic connection with, San Pedro Formation aquifers in the vicinity of the Omega site. Subsurface explorations conducted near the site to date, however, have identified clays underlying the suspected Gage- equivalent sand unit.

The five aquifers defined within the San Pedro Formation include, from top to bottom, the Hollydale, Jefferson, Lynwood, Silverado, and Sunnyside. The upper two aquifers are less extensive and appear to be absent in the immediate vicinity of the Omega site.

The San Pedro aquifers consist of varying amounts of sand and gravel with some interbedded clay. The thickness of the aquifers increases with depth. The shallow Hollydale Aquifer ranges from 10 to 25 feet, whereas the deepest Sunnyside Aquifer ranges from 200 to 300 feet. The base of the Sunnyside Aquifer reaches a maximum depth of about 1,000 feet bgs (CDWR, 1961). The San Pedro Formation aquifers are the primary source of water for the production wells in the area.

The Pliocene and Miocene sediments below the San Pedro Formation generally contain saline water in the area, but locally contain freshwater (CDWR, 1961).

Based on a records search by England-Hargis (1996), there are six water supply wells within 1.5 miles of the site. The nearest well, Well No. 02S/11W30-R3, also known as Santa Fe Springs Well No. 1 (SFS#1), is located 1.3 miles to the west-southwest of the former Omega Facility, at the Santa Fe Springs Fire Station on Dice Road near Burke Street. The well is screened from 200 to 288 feet bgs and 300 to 900 feet bgs. Aquifers that are tapped by SFS#1 are believed to include the Silverado and Sunnyside Aquifers, which occur within the lower part of the Lower Pleistocene San Pedro Formation. In several years of monitoring SFS#1, low concentrations of chlorinated hydrocarbons (including TCE, chloroform, and PCE) have occasionally been detected. Most recently (in February 2003), only TCE at a concentration of 0.64 microgram per liter ($\mu\text{g/L}$) was reported above the detection limit. Hexavalent chromium was reported at a concentration of 2.6 $\mu\text{g/L}$. The depth interval(s) from which the contamination is entering the well has not been established. The production rate of SFS#1 ranges up to approximately 1,250 gallons per minute (gpm) (England and Hargis, 1996). It is not established what effect well SFS#1 has on local groundwater flow direction and contaminant migration; shallow groundwater in the vicinity of the well appears to flow toward the south, unaffected by pumping from SFS#1 (Weston, 2003).

The Los Nietos water supply well (Well No. 02S/11W30-Q5) is located about 1.5 miles southwest of the site (about 1,500 feet west-northwest of SFS#1). This well is screened from 152 to 370 feet bgs. PCE and TCE were detected at unknown concentrations from 1986 through 1990 (Weston, 2003). The well locations are shown on Figure 3-1.

The remaining wells (Well Nos. 2S/11W-29E5, 2S/11W-32G3, 2S/11W-33M1, and 2S/11W-32J4) are no longer operating, are used for irrigation, no water-quality data were available, or their exact locations are unknown (Weston, 2003).

2.3.2 Site Hydrogeology

The hydrogeology of the Omega site has been explored with borings and Cone Penetrometer Testing (CPT). The former Omega Chemical site is underlain by relatively low permeability silty and clayey soils to a depth of about 120 feet bgs. A sand unit, which may correlate with the Gage Aquifer, has been encountered approximately 600 feet southwest of the site beneath Putnam Street. Groundwater at

OU-1 generally occurs at a depth of approximately 70 feet bgs. The depth to groundwater ranges between 40 and 70 feet over OU-2. Locally, groundwater flow appears to be generally to the southwest. CDM (1999) reported a local direction of groundwater flow toward the southwest with a hydraulic gradient of 0.009 foot per foot (ft/ft). TDS concentrations of greater than 3,000 milligrams per liter (mg/L) were reported in shallowest groundwater samples collected by CDM (1999).

The hydraulic conductivity of the upper silty unit was estimated from step-drawdown tests conducted in Monitoring Well OW2 and a slug test at Monitoring Well OW1. The hydraulic conductivity in this area was found to range from 0.8 to 1.6 feet per day (CDM, 2003a). The hydraulic conductivity of the more permeable units southwest of Omega is not known.

2.4 Nature and Extent of Contamination

2.4.1 Nature of Contamination

Groundwater at the Omega site has been impacted primarily by chlorinated hydrocarbons and Freon compounds (i.e., volatile organic compounds [VOCs]). The following summary is based on the results of the Phase 2 Groundwater Characterization Study conducted by Weston Solutions, Inc. (Weston, 2003).

The five primary chlorinated compounds detected in groundwater are:

- PCE
- TCE
- 1,1-DCE
- Cis-1,2-DCE
- Chloroform

These are the most widespread VOCs detected in groundwater in the vicinity of the Omega site.

Eight other VOCs were locally detected in groundwater in lower concentrations. These compounds include:

- 1,2-dichloroethane (1,2-DCA)
- 1,1-dichloroethane (1,1-DCA)

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- 1,1,1-trichloroethane (1,1,1-TCA)
- Trans-1,2-dichloroethene (trans-1,2-DCE)
- 1,2-dichloropropane
- Vinyl chloride
- Methylene chloride
- Carbon tetrachloride

Freon compounds reportedly detected at the site include:

- Freon 11
- Freon 113

As part of Weston's investigation, groundwater samples from monitoring wells were also analyzed for metals, as well as some indicators of the potential for occurrence of natural attenuation processes including total organic carbon (TOC), total Kjeldahl nitrogen (TKN), sulfate, sulfide, and methane/ethane/ethene. Of these analytes, total chromium was the most significant with respect to groundwater impacts originating from the Omega site versus other potential contamination sources. At some monitoring wells, chromium concentrations approached or exceeded the maximum contaminant level (MCL) of 50 µg/L for drinking water (Weston, 2003).

CDM (1999, 2003b) also reported low detections of aromatic hydrocarbons (toluene, acetone, xylenes, ethylbenzene, and benzene) in samples from shallow wells at the former Omega Chemical Facility. However, toluene and acetone concentrations of up to 900 µg/L and 6,300 µg/L, respectively, have been detected in samples from Well 0W8 located approximately 250 feet downgradient of the Omega site, on Putnam Dr. The increase in concentrations downgradient of the Omega facility suggests that an additional source of these constituents may be contributing to groundwater contamination (CDM, 2003b).

2.4.2 Extent of Contamination

Figures 2-2 through 2-5 present chemical distribution maps for PCE, TCE, Freon 11, and Freon 113 in groundwater, respectively. Maps for these particular analytes are presented because of their widespread distribution and reportedly higher concentrations offsite of Omega. The maps contain data from Phase 1 and Phase 2 investigations conducted by Weston Solutions, Inc (2003). The data points include

results from push-probe sampling (PP), soil borings (B), EPA monitoring wells (MW), and OPOG monitoring wells (OW). The contours are presented as drawn by Weston (2003) without modification.

As shown on Figure 2-2, the PCE plume extends approximately 2 miles downgradient west-southwest of the Omega site, with a width approaching 0.75 mile. The maximum PCE concentration observed at the site was in groundwater from soil boring B109 (53,000 µg/L), which is located less than 500 feet west of Omega. High PCE concentrations were also reported at other borings in the immediate area (locations B108 and B110). The PCE concentrations at borings B108 and B110 were 5,100 µg/L and 8,000 µg/L, respectively. Concentrations above 1,000 mg/L comprise about 5 percent of the area of the PCE plume, occurring primarily within approximately 2/3-mile downgradient of the Omega site. Most of the PCE plume is characterized by concentrations in the range of 10 to 100 µg/L. An isolated area of relatively high concentrations of PCE was reported at locations PP058 and PP066 (3,300 µg/L and 850 µg/L, respectively), indicating the likely presence of a separate source area in this region. Because the majority of the monitoring points that have been used to define the VOC plumes are based on *in-situ* groundwater samples from CPT soundings, which sample only a very small depth interval, it is possible that some of the lateral variation in concentrations is a result of the limitations of this sampling technique.

The TCE plume (Figure 2-3) is similar in extent to the PCE plume, but is narrower and exhibits lower concentrations overall. The majority of the TCE plume comprises concentrations between 10 and 100 µg/L, but concentrations exceeding 100 µg/L appear to be more continuous (if less extensive) than for the PCE plume. The highest concentration parts of the TCE plume (greater than 1,000 µg/L) occur in apparently unconnected zones near the Omega site. The narrower and smaller occurrence is nearly coincident with the estimated extent of 10,000 µg/L PCE concentrations immediately downgradient from the Omega site. The other area of 1,000 µg/L TCE begins with a concentration of 7,000 µg/L at its northeastern end (location B103) and continues west-southwest for approximately 3,000 feet. Unlike PCE, elevated TCE concentrations occur northwest of the Omega site in concentrations ranging from approximately 200 to 960 µg/L.

The Freon 11 plume (Figure 2-4) and Freon 113 plume (Figure 2-5) are approximately one-half to two-thirds the width of the PCE and TCE plumes; however, the downgradient extent is approximately 90 percent that of the TCE and PCE plumes. The plumes are well defined by groundwater samples with detected

concentrations less than 2 µg/L to the north, west, and south sides. Aside from the smaller downgradient extent and lower concentrations of the Freons (800 µg/L maximum for Freon 11 and 2,400 µg/L for Freon 113), the distribution of the Freons is similar to that of PCE and TCE. The southwestern end of the Freon 113 plume encompasses the isolated area of elevated (greater than 1,000 µg/L) PCE concentrations some 8,000 feet from the Omega site. The Freon 11 plume also extends to this area. The Freon concentration contours are drawn (Weston, 2003) as discontinuous (Figure 2-5); however, the data may also be interpreted as one continuous plume similar to the Freon 113 plume.

Data indicative of the vertical distribution of contamination include groundwater samples from co-located monitoring wells screened at different depths and co-located direct-push samples collected at different depths. In most cases, contaminant concentrations were much lower at deeper intervals, particularly where intervening fine-grained units restricted downward migration (Weston, 2003). Almost all groundwater samples were collected from depths less than 100 feet bgs, or about 30 to 60 feet below the water table. It is anticipated that within the known extent of the VOC plume, significant contaminant concentrations in groundwater are limited to the shallow zone of approximately 30 to 60 feet below the water table. Locally, however, the contamination may be present in deeper, highly permeable units that serve as preferential groundwater flow pathways. Also, further downgradient the contamination is expected to migrate deeper as a result of area recharge to the aquifer.

2.4.3 Potential Pathways of Contaminant Migration

In their original version of this FSP, CH2M Hill used an estimated contaminant migration rate when they evaluated the locations of the proposed wells at the downgradient (leading) edge of the plume. In their evaluation, CH2M Hill used the site history and estimated extent of the contamination in groundwater to provide an indication of the plume migration rate. It should be noted that this evaluation does not account for other possible sources between Omega and the downgradient edge of the plume. The Omega site started operations in 1976. Assuming a continuous release started during the first year of operations, the plume is continuous and from one source, and the downgradient edge of the plume was approximately 13,000 feet southwest from the Omega site in 2002 (26 years after start of operations at Omega) CH2M Hill estimated the average contaminant migration rate to be 500 feet per year (13,000 feet divided by 26 years). CH2M Hill stipulated that it is also possible that the contamination found in portions of the downgradient area of the plume originated

entirely from sources other than the Omega site. In such a case, the contaminant migration could be slower.

The elevated VOC concentrations in the general vicinity of the intersection of Dice Road and Los Nietos Road (Figures 2-2 to 2-5) may have originated from sources other than the Omega site. Groundwater contours for February-March 2003 (Figure 2-6) and for May-June 2003 (Figure 2-7) indicate that this area is downgradient of several industrial facilities with known groundwater contamination (such as the former McKesson Corporation and Angeles Chemical sites, located at 9005 and 8915 Sorensen Avenue, just south and north of the railroad tracks, respectively [near borings PP061 and PP050]). Production well SFS#1 is located north of the anticipated flow path from the Omega site, indicating that the low VOC concentrations occasionally observed in the well may have originated from other sites.

The advective velocity of the plume estimated by CH2M Hill will likely be revised using pumping test data obtained from the extraction well to be installed as part of the scope of work outlined in this document, as well as additional data obtained in the future.

3. Rationale for Sample Locations, Number of Samples, and Laboratory Analyses

This section presents the overall rationale for the sampling and analysis associated with this RI. A description of the sample locations, number of samples, and laboratory analyses to be performed on those samples also is provided. The number and location of samples collected may vary depending on changes in the scope of work.

As discussed in Section 1, and in the data quality objectives (DQOs) included in the accompanying QAPP, the sampling activities will address the following:

- Installation of additional groundwater monitoring wells to (1) further assess the nature and extent of groundwater contamination; (2) provide additional information regarding the subsurface geology and contaminant transport; (3) provide locations for measurement of water levels to assess groundwater flow directions; and (4) provide permanent monitoring locations that can be used to assess changes in contaminant concentration over time.

- Sampling of investigation-derived waste (IDW), including drill cuttings, well development water, well purge water, and potentially drilling mud, to determine the appropriate disposal option.
- Groundwater sampling to assist in identifying additional potential sources of groundwater contamination.
- Baseline groundwater sampling to evaluate the potential presence of "emergent" groundwater contaminants (1,4-dioxane, perchlorate, N-nitrosodimethylamine [NDMA], hexavalent chromium, and 1,2,3-trichloropropane [1,2,3-TCP]).
- Groundwater sampling and analysis of parameters for evaluation of groundwater treatment options and options for discharge of treated groundwater.

The following sections detail the proposed objectives of various activities, including well installation, groundwater monitoring, and IDW management.

3.1 Well Installation

During the remedial investigation, 11 monitoring wells or clusters and one extraction well will be installed to further characterize the nature and extent of contamination and to characterize the site hydrogeology. The new groundwater wells will be installed to:

- Further characterize the vertical and lateral extent of contaminant distribution in groundwater within the OU-2 study area, and better define the contaminant distribution within the plume.
- Investigate the potential presence of emergent contaminants.
- Further define aquifer stratigraphy and estimate aquifer hydraulic properties from aquifer pumping tests and slug tests. (Aquifer tests and slug tests will be performed by EPA contractors and are not part of this RI Work Plan.)
- Better define groundwater flow direction in the downgradient portion of the plume.
- Assess vertical flow gradients and provide permanent monitoring points for measuring groundwater elevations.

- Provide permanent monitoring points for tracking contamination in the downgradient plume area and contaminant distribution within the plume. A baseline groundwater sampling event will be performed by ARCADIS on behalf of OSVOG. Quarterly groundwater monitoring of the wells will be performed by EPA for 2 years to evaluate long-term concentration trends and to generate sufficient data to accurately assess representative concentrations.

3.1.1 Well Location Rationale

Eleven monitoring wells or well clusters (location Nos. PMW12 to PMW22) and one extraction well (location No. PEW1) are proposed for construction in the OU-2 study area. The rationale for the proposed well placement and their location is summarized in Table 1. Figure 3-1 shows the locations of the EPA-proposed wells and screen depths, as well as the locations of existing EPA and OPOG monitoring wells. The proposed wells are also shown on the PCE, TCE, Freon 11, and Freon 113 plume maps (Figures 2-2 through 2-5). The proposed well names start with "PMW" and continue with a sequential number (e.g., PMW15). They are numbered sequentially from east to west, not in the order in which they will be installed (the installation of some of the wells will be postponed, as discussed below). Once installed, the wells will be numbered in a sequence with the existing wells in the order of installation (i.e., starting with MW12).

A combination of single-screen monitoring wells and well clusters are proposed. Well clusters will allow monitoring of hydraulic heads and contaminant concentrations at different depth zones. In the downgradient area of the plume, well clusters are also more likely to intercept contamination that may have spread over a greater extent and depth in the aquifer compared to locations closer to the source. The well clusters will be installed as multi-completion wells within one or two borings. Two three-well clusters are proposed.

Single-screen wells will be installed at the remaining locations. The well screen intervals will be selected based on the results of discrete-depth groundwater sampling during drilling; the depth interval with the highest contaminant concentration will be screened. If discrete-depth sampling results indicate that groundwater contamination extends over more than one permeable unit, a well cluster will be installed at that location instead of a single well.

As shown on Figure 2-2, proposed monitoring well clusters PMW17 and PMW20 are situated along the suspected axis of the PCE contaminant plume in the downgradient area. Well PMW17 is proposed downgradient of a high-concentration area exceeding 1,000 µg/L that is located approximately 8,000 feet downgradient of the Omega site and approximately two-thirds of the distance to the leading edge of the plume. A cluster of two to three wells is proposed here instead of a single well to allow monitoring of heads (to assess vertical flow gradients) and contaminant concentrations in groundwater at different depths. For logistical and ease of access, ARCADIS proposes to install this well on public right of way, between the EPA proposed location and boring PP066, as shown on Figures 2-2 and 3-2.

Well PMW20 will be situated close to the anticipated leading edge of the plume. A cluster of wells, instead of a single well, is proposed at this location because the depth interval of the contaminated aquifer is expected to increase with distance from the source area(s). A well cluster will allow for monitoring of contaminant concentrations and heads at different depths. A well cluster is also more likely to intercept contamination that may migrate to this location at a later time than a single well. As EPA proposed well PMW20 is one of five proposed wells along the estimated edge of the plume, ARCADIS proposes an alternate, downgradient, location to account for plume migration as discussed in the next paragraph. The EPA proposed well location and ARCADIS' alternate well location are shown on Figure 3-2.

In comments to the Draft Field Sampling Plan (ARCADIS, November 18, 2004), EPA directed OSVOG to install a new well, designated herein as well PMW23, between historical hydropunch locations PP035 and PP052. The purpose of this well is to characterize the continuity and nature of contamination upgradient of the McKesson HBOC site and the Angeles Chemical Corporation site. The construction of Well PMW23 will be based on the vertical distribution of VOCs.

EPA proposed monitoring wells PMW19, PMW21, and PMW22 are situated near the suspected leading edge of the contaminant plume and will assist in characterizing the lateral extent of contamination downgradient of the Omega Site. Well PMW18, at the lateral edge of the plume, will be located just southwest of the intersection of Santa Fe Springs Road and Ann Street, between existing wells MW11 and MW07. The purpose of this cluster well is to evaluate whether contamination detected beneath the WDI site (at the corner of Santa Fe Springs Road and Los Nietos Road) is present upgradient of WDI, and if it is present in similar depths. Installation of these wells will also provide additional information on groundwater elevations and

aquifer materials. These wells are proposed in areas of expected low concentrations. The proposed well locations may be modified based on the results of the investigation (cluster wells PMW17 and PMW20 will be installed before the leading-edge wells). The downgradient extent of the contamination as shown on Figures 2-2 to 2-5 is unknown because no data are available from the downgradient area. Preferably, the new downgradient wells would be installed in a zone where contaminant concentrations range between non-detects (NDs) and MCLs to characterize the plume leading edge. Toward this goal, ARCADIS proposes alternate sentry well locations as shown on Figure 3-2. Note that the alternate proposed location for well PMW20, PMW20A-alt is located more along the centerline of the plume than well PMW20 as depicted in this figure. Also of note, there are two proposed alternate locations for PMW22, ARCADIS' first choice for an alternate location is denoted by PMW22A-alt and the second choice for an alternate location is denoted by PMW-22B-alt. These alternate well locations are based on CH2M Hill's assumption that the plume is migrating at approximately 500 feet per year. The groundwater plume outlines on Figures 2-2 through 2-5 are based on data from 2001 to 2002. The leading edge of the plume (data from August 2002) is therefore likely to have migrated up to 1500 feet downgradient of that shown on the figures. ARCADIS located alternate well locations approximately 750 feet downgradient of EPA-proposed locations to account for this migration. Furthermore, ARCADIS proposes to sample these alternate locations using a CPT rig to evaluate contaminant concentrations in groundwater prior to well installation. Should contaminant concentrations detected in groundwater samples from these alternate locations exceed MCLs, groundwater monitoring wells will not be installed at these locations and additional locations farther downgradient will need to be evaluated.

Well PMW16 is situated slightly north of the axis of the plume, downgradient of McKesson HBOC, Inc. and Angeles Chemical Corporation, and upgradient of the "greater than 1,000 $\mu\text{g/L}$ " hot spot located in the vicinity of Los Nietos Road and Pacific Street (see Figure 2-2), where potential sources of contamination other than the Omega site may be present. This well location is approximately midway between historical hydropunch samples PP057 and PP069. This well will be installed to characterize the distribution of contamination within the plume. There is an apparent low-concentration zone at this location (Figure 2-2 PCE), and a high-concentration zone just downgradient, as characterized by a former direct-push investigation. This well will verify the continuity of the plume. The installation of this well will be postponed until after an investigation of the source areas. Well construction (single well or cluster well) will be determined based on results of discrete groundwater sampling.

ARCADIS

Field Sampling Plan

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Operable Unit 2,
Whittier, CA

Well PMW15 is situated in an apparent high-concentration area approximately 3,000 feet downgradient of the Omega site and will verify the plume continuity. The installation of this well will be postponed until after an investigation of the source areas.

Well PMW14 is proposed in a high-concentration area of the plume, approximately 1,700 feet downgradient of the Omega site, to verify the plume continuity, vertical contaminant distribution, and to characterize the lithology downgradient of the Omega site.

Well PMW12 is proposed approximately 1,100 feet north-northwest of the Omega site, on Baldwin Road adjacent to the Tool & Jig Plating Company (7635 Baldwin Place), in an area of contamination that likely originated from source other than the Omega facility. The installation of this well will be postponed until after an investigation of the source areas. ARCADIS proposed an alternate location for PMW12 (PMW12A-alt) in a private driveway adjacent to and immediately downgradient of the Tool & Jig Plating Company. The purpose of well location PMW12, according to the CH2M Hill Field Sampling Plan (FSP) of July 2004, was to "Provide information on contaminant distribution in an area that may have been impacted by a source other than Omega." Elevated trichloroethylene (TCE) concentrations were detected in sampling location PP048 during Weston's groundwater assessment of 2003.

The alternate well location PMW12A-alt is more centrally located inside the TCE plume downgradient of PP048, as shown on CH2M Hill's Figure 2-3. This location is directly downgradient of two possible sources for solvent contamination: A&K Manufacturing (manufacture fire grates) and Tool & Jig Plating Company, located on the northwest side of Baldwin Place. Two additional potential sources in the vicinity include, Legget & Platt (a textile manufacturer), located along Whittier Boulevard just northwest of PP048; and Pacific Cutting Dies, Inc., a machine shop located on the southeast side of Baldwin Place. It is, therefore, our belief that the proposed location will provide slightly better information as to plume continuity (relative to PP048) and possible sources for VOC contamination in this area of the plume.

Well PMW13 is proposed approximately 800 feet west-northwest of the Omega site in an area of contamination that may have originated from the Omega site and/or another source. This well will provide information on aquifer materials as well as contaminant distribution. The installation of this well will be postponed until after an investigation of the source areas. The contaminant concentration distribution in this

area is uncertain; it is largely known from direct-push sampling only. Another well may need to be installed in this area.

Extraction well PEW-1 is proposed to be constructed just south of the existing MW8 well cluster. The extraction well will serve as a pumping well for an aquifer test that will be conducted to estimate aquifer hydraulic properties in this area. This location was selected because it is downgradient of a zone of high contaminant concentrations and is interpreted to be within a highly permeable, laterally extensive zone that provides a preferential contaminant transport pathway from the Omega site. The contaminant concentrations detected in samples from the MW8 well cluster decreased with depth (PCE and TCE concentrations of 580 and 120 $\mu\text{g/L}$ in the top screen interval MW08A decreased to 14 and 3 $\mu\text{g/L}$ in MW08B, respectively), indicating that the top screen interval intercepts the main contaminant transport pathway (Weston, 2003). The test will assess the hydraulic communication between the contaminated shallow and relatively clean deeper aquifer zones and will provide estimates of hydraulic properties of the shallow zone aquifer. The deeper screens of Well MW08 are believed to have intercepted regional aquifers (starting with Gage and Hollydale Aquifers from the top) that can potentially become major contaminant transport pathways (Weston, 2003). Pumping from the less contaminated zone will also allow onsite treatment of the extracted groundwater.

The new wells will be installed in two phases. Wells PMW14, PMW17, PMW18, PMW19, PMW20, PMW21, and PMW22 will be installed first to characterize the extent of the contamination, aquifer stratigraphy, and groundwater flow patterns. While well PMW17 is being installed at the ARCADIS-proposed alternate location (upon EPA approval), groundwater at the ARCADIS-proposed alternate locations for wells PMW19, PMW20, PMW21 and PMW22 will be evaluated using the CPT. If contaminant concentrations at these locations are less than MCLs, wells will be installed at these locations. The installation of wells PMW12, PMW13, PMW15, and PMW16 will be postponed to consider the results of the first phase and also the results of the investigation of the potential source areas other than the former Omega Chemical Corporation site. The proposed locations for the second-phase wells are tentative and will likely be revised based on the new information.

3.1.2 Rationale for the Collection of Depth-Discrete Groundwater Samples

Discrete-depth, screening-level groundwater samples will be collected from the boreholes for the monitoring wells in order to select a screen-depth interval within the contaminated zone. The samples will be taken through the drive-casing using a

disposable bailer. The first depth-discrete water sample will be taken immediately below the water table.

3.1.2.1 Depth-Discrete Water Sampling Using ARCH and Sonic Drill Rigs

If a thick coarse-grained (sandy) aquifer unit is encountered, the depth-discrete water samples will be collected every 10 feet for a total of five samples. If alternating layers of saturated coarse and fine-grained (silts and clays) sediments are intercepted by the borehole, groundwater samples will be taken from the coarse-grained units. The total number of samples taken may be adjusted according to encountered stratigraphic conditions and laboratory results. If contamination above MCL is detected in the lowest sample, drilling will continue to a greater depth and additional samples will be taken. If the contaminated zone with concentrations above MCL spans more than 30 feet within one permeable unit, the length of the well screen will be increased (in 5-foot increments, based on the thickness of the contaminated zone) from the proposed 15-foot screen length. If contamination above MCLs is found in two or more permeable zones separated by low-permeability units, a multiple-completion well or a well cluster will be installed.

3.1.2.2 Depth-Discrete Water Sampling Using CPT Rigs

For well locations PMW19A-alt, PMW20A-alt, PMW21A-alt and PMW22A-alt, along the leading edge of the plume, depth-discrete groundwater samples will initially be collected using a CPT rig, as discussed in Section 3.1.1 of this document. Depth-discrete water samples will be collected using the CPT rig using rationale similar to that used for those collected using the ARCH and Sonic drilling rigs. If groundwater conditions from the samples collected meet the lateral extent criteria, those sample depths at which discrete groundwater samples could not be collected using the CPT rig, would be collected with either the Sonic or ARCH drill rigs during well installation.

3.1.2.3 Rationale for Chemical Analysis of Depth-Discrete Water Samples

The purpose of the depth-discrete water samples is for screening purposes – to evaluate the vertical distribution of contaminants, in particular PCE and TCE. Depth-discrete water samples will be analyzed for VOCs by a stationary, land-based, State-certified laboratory using EPA Method 8260B. A 24-hour or shorter turnaround time will be required for the samples to allow for timely decisions regarding well construction. The samples will be picked up by courier once or twice a day with immediate turn around. It is anticipated that the borehole for each well

will be drilled in 2 to 3 days and the analytical results will be needed the following day. The drill rig will remain at the site until the analytical results are available for the decision on the screen-depth intervals or to continue drilling to a greater depth. The borings will be drilled and wells installed sequentially. The time anticipated to complete the drilling and installation of a single well is approximately 3 to 4 days. Cluster wells may require 5 to 6 days. For cluster wells, the deepest well will be installed first, followed by the shallower wells.

The estimated total number of the discrete samples is 55 samples (5 samples per each borehole). As these samples are for screening purposes only, no quality control (QC) samples will be collected during well installation.

3.2 Groundwater Monitoring

ARCADIS, on behalf of OSVOG, will perform one baseline round of groundwater monitoring and sampling of the newly installed wells (MW12 through MW22) in accordance with the UAO.

3.2.1 Sampling Rationale

Analysis of VOCs with low-detection limits will be used to assess the magnitude of groundwater contamination in the new monitoring wells and to determine whether any of the VOCs detected exceed regulatory limits. The rationale for the VOC analyses is that VOCs are the most prevalent contaminants known to have originated from the Omega site. Sampling for VOCs will be included in all sampling events. Sampling for metals, semi-volatile organic compounds (SVOCs), emergent chemicals (NDMA, perchlorate, 1,4-dioxane, 1,2,3-TCP, and hexavalent chromium) will be conducted to evaluate exceedances of regulatory limits and to assess the need for continued monitoring or future treatment for these analytes. The rationale for these analyses is that many of the compounds have state or federal MCLs, California action levels, or other regulatory limits, and have been detected in areas of OU-2 where VOCs are present. They also require significantly different treatment methods for removal from groundwater compared to VOCs. Remedial action at OU-2 will have to address these compounds in addition to VOCs.

The analysis for emergent chemicals (NDMA, perchlorate, 1,4-dioxane, 1,2,3-TCP, and hexavalent chromium) will be conducted for two consecutive sampling events (one by OSVOG and the second by EPA). Chemicals that are not detected during the two events will not be subsequently analyzed for.

In the Scope of Work attached to EPA's First Amended UAO, EPA directed OSVOG to additionally analyze the water samples for parameters such as nitrogen, sulfates and total organic carbon, used to assess natural attenuation of the contaminants.

Two rounds of groundwater samples will be analyzed (by EPA) for major ions (calcium, magnesium, potassium, sodium, bicarbonate, chloride, and sulfate), total phosphorus, nitrate and nitrite as nitrogen, ammonia, cyanide, TDS, biological oxygen demand (BOD), chemical oxygen demand (COD), TOC, alkalinity, and pH to evaluate treatment design issues such as granular activated carbon (GAC) usage, mineral precipitation, and potential clogging or bio-fouling problems within a treatment system. All of the preceding sample analyses will be also used to evaluate the treatment discharge options.

3.2.2 Assessment of Regulatory Requirements

The applicable or relevant and appropriate requirements (ARARs) for waters in the State of California have been summarized by California EPA, Regional Water Quality Control Board, Central Valley Region in a compilation of water quality goals published in August 2003 (Cal-EPA, 2003), and subsequent changes in MCLs, Action Levels, and the Department of Health Services (DHS) list of unregulated chemicals required to be monitored. The ARARs relevant to the development of this FSP have been summarized in Table 2. The human health standards of the CTR are not applicable, since a court case was recently resolved that determined that CTR criteria are not applicable to surface water reaches with a beneficial use designated as potential municipal.

The compounds listed in Table 2 include selected constituents regulated for drinking water that are relevant to the Omega site. Future investigations at Omega, namely the planned investigation of potential source areas other than the former Omega Chemical Corporation site, may need to include analyses for other compounds identified as potential contaminants. Based on the results of a records search currently being performed by EPA, the list of analytes will be revised for the source investigation to include the additional compounds.

The *Water Quality Control Plan, Los Angeles Region* (LARWQCB, 1994) (Basin Plan) requires reuse of treated groundwater. The site remedy for groundwater will need to include treatment that meets drinking water standards, because of the potential for the use of treated groundwater for reclaimed water, surface water discharge, and groundwater recharge beneficial use. Depending on the outcome of

the FS, the entire suite of analytes required by drinking water regulations may be included in later phases.

Additional standards that apply for the protection of fresh water aquatic life are considered for the FS phase of this investigation because discharge of treated groundwater to storm drains or other conduits will likely be considered. No surface water bodies are present at OU-2. The Sorensen Avenue Drain and the La Canada Verde Creek (concrete lined), however, are both downgradient of the Omega facility. A portion of the Sorensen Avenue Drain runs through the OU-2 plume. Regulatory requirements applicable to these discharge methods were reviewed to determine which constituents require analysis and the necessary detection limits for each of the analytes or analyses.

The information in Table 2 was used to determine appropriate analytical methods and required laboratory detection limits to meet the regulatory requirements.

3.2.3 Number and Location of Samples

In the First Amended UAO Scope of Work, EPA directed OSVOG to perform only one round of groundwater monitoring of the newly installed wells (MW12 to MW22). According to EPA, 15 water samples will be collected, not including QC samples. Should additional cluster wells be installed during the RI, additional groundwater samples will be collected.

In addition to groundwater samples, field QC samples will be collected in the form of duplicates, blanks, and MS/MSD samples. At a minimum, one field duplicate will be collected for each analysis for every 10 wells/screens sampled or one per week, whichever is larger. An attempt will be made to collect duplicate samples from a well that is expected, or known to be, moderately contaminated.

Equipment blank samples will be collected to check for possible cross-contamination of groundwater samples after decontamination of common equipment used to collect samples from a number of different wells or screens in a given day. The number of equipment blanks will be 10 percent of the number of primary samples. One equipment blank will be collected for every 10 field samples (thus, two blanks would be collected for a batch of 15 samples). As ARCADIS, on behalf of OSVOG, will be performing only one round of groundwater monitoring of the newly installed wells, a dedicated bladder pump will be installed in each new well, for the baseline sampling

of wells MW12 through MW22. Quality assurance samples for these wells will include equipment blanks as mentioned above.

Field blank and trip blank samples will be collected to check for possible cross-contamination of groundwater samples by VOCs from the point of sample collection to analysis of the samples by the laboratory. Field blanks will be collected at a rate of 10 percent of the primary samples (one blank for every 10 samples). Trip blanks will be collected only if VOCs are found in the equipment or field blank samples. Analyses for BOD, COD, and alkalinity do not require blanks.

Laboratory QC samples (MS/MSDs) will be identified for all analyses during each sampling event. One MS/MSD sample per analyte will be identified for every 20 primary samples collected. A double volume of sample is collected for each MS/MSD. Temperature blanks will be used to determine that the samples have been maintained at the appropriate temperature of 4 degrees Celsius (°C). Temperature blanks will be prepared each day samples are collected and will be included with each cooler of samples sent to the lab.

3.2.4 Laboratory Analysis

Unless otherwise noted, laboratory analyses will be performed by a NELAP-accredited, State-certified laboratory. Groundwater samples will be analyzed by using the methods described below.

Constituents Tested For	Analytical Method
VOCs	EPA Method 8260B
SVOCs	EPA Method 8270C
Metals	EPA Method 6010/7000
Emergent Chemicals: 1,4 Dioxane NDMA Perchlorate Hexavalent chromium 1,2,3-trichloropropane	EPA Method 8270C EPA Method 1625 Modified EPA Method 314 EPA Method 218.6 EPA Method 8260 Sim
Additional Parameters Cyanide Nitrogen-N Total Kjeldahl Nitrogen Total sulfates Total organic carbon	EPA Method 335.2 EPA Method 300 EPA Method 351.3 EPA Method 300 EPA Method 415.1

Analytical methods and detection limits are presented in Table 3.

3.3 Investigation Derived Waste

Liquid and solid IDW will be generated during drilling, development, and sampling of the proposed monitoring wells. Each of these wastes may potentially be contaminated with VOCs. Samples of the drill cuttings, drilling fluids, and development water will be collected from their storage units prior to removal from the site to evaluate the proper storage, disposal, or discharge of the waste materials. The following subsections describe each of the wastes and the sampling procedures that will be used to characterize the wastes.

3.3.1 Drill Cuttings and Fluids

Drill cuttings and fluids will be generated during drilling of the monitoring wells. The drill cuttings will be contained in roll-off bins stored at each well site. Two grab samples will be collected for every 50 cubic yards of drill cuttings. Samples will be collected from bins that contain cuttings representative of the dominant soil material encountered during drilling. In the past, attempts have been made to use photoionization detector (PID) organic vapor reading to select cuttings for analysis. However, based on previous experience in the Whittier Narrows OU and Puente Valley OU, no organic vapors have been detected during monitoring of drill cuttings during drilling and logging of the cuttings. Thus, PID organic vapor monitoring or readings are unlikely to be useful for screening cuttings for sample collection.

Drilling fluids (water and mud) will be containerized in tanks and stored onsite at each well location. One sample of drilling fluid will be collected per tank. It is likely that the drilling fluid in each tank will be fairly homogeneous as a result of recirculation, mixing, and agitation during the drilling process. Thus, one sample per tank should be sufficient to characterize the fluids in the tank. Because drilling mud tends to separate into the heavier mud at the bottom and lighter water near the top of the tank, the sampling bailer will be lowered near the bottom of the baker tank to collect a fluid sample with a high solids content.

The drill cuttings and fluids will be analyzed for the following, according to local landfill requirements:

- pH
- Flashpoint

- Total Petroleum Hydrocarbons - Gasoline (TPHg)
- Total Petroleum Hydrocarbons - Diesel (TPHd)
- VOCs
- Total Threshold Limit Concentration (TTL) Metals

The analyses listed above have been performed on wastes generated previously during well installation activities associated with VOC contamination in the Whittier Narrows and South El Monte OUs and none of the wastes have been classified as hazardous. A quick turnaround time (7 days) will be necessary for characterization and disposal of the drill cuttings and fluids to avoid costs associated with long-term storage of the wastes. Analytical methods for IDW are summarized in Tables 6 and 7.

3.3.2 Development and Purge Water

During development and sampling of the wells, water will be generated that has the potential to be contaminated. Water generated from well development and sampling activities will be contained in tanks and stored temporarily at a central location onsite. One groundwater sample per tank will be collected. It is likely that the water in each tank will be fairly homogeneous as a result of mixing and agitation during the tank filling. Thus, one sample per tank should be sufficient to characterize the water. When collecting the sample from a tank, the sampling bailer will be lowered to the middle of the tank to avoid any water near the water surface that may have been affected by evaporation.

Well development and purge water samples will be analyzed for the following:

- VOCs
- SVOCs
- 1,2,3-Trichloropropane
- NDMA
- Perchlorate
- Nitrate
- 1,4-Dioxane
- Hexavalent Chromium
- Dissolved Metals

The rationale for the chemical analyses listed above is based on review of regulatory levels, as described in the companion QAPP, and evaluation of the parameters required to profile the liquid for treatment. A turnaround time of 7 days will be necessary to characterize and dispose of the development and purge water to avoid costs associated with long-term storage of the wastes.

4. Request for Analyses (RFA)

This section presents the RFA and anticipated sampling schedule.

4.1 Analytical Parameters

Tables 4, 5, 6, and 7 summarize the analytical parameters and test methods for the samples that will be collected and submitted during the OU-2 groundwater sampling, discrete-depth sampling, waste water sampling, and waste soil sampling, respectively. The tables also indicate the sample preservation requirements, analytical holding times, sample container requirements, and the laboratory anticipated to perform the analysis. As previously discussed, trip blanks will be prepared and maintained for all post-well-installation groundwater sampling events. The trip blanks will only be analyzed if contamination is found in field or equipment blanks.

Target compound lists and reporting limits for all samples to be collected during this project (as approved by EPA) are included in Tables 1 and 2. Standard turnaround times will be required for the groundwater sampling, 24-hour turnaround time will be required for the discrete-depth samples, and 5-day turnaround time will be required for IDW profiling samples.

4.2 Schedule

The installation of the proposed wells will proceed per EPA's direction. The start of this work is not anticipated before January 2005.

Groundwater sampling of the proposed wells will commence after they are constructed

5. Field Methods and Procedures

This section of the FSP provides information on field activities associated with the OU-2 study area. Included in this section are methods and procedures for the following:

- Monitoring well drilling and construction;
- Groundwater sampling;
- Use of sample containers and preservatives;
- Decontamination;
- Containment and disposal of IDW;
- Sample management and documentation; and
- QC sample collection.

5.1 Monitoring Well Construction

5.1.1 Well Drilling

Monitoring wells constructed for the OU-2 investigation will either be drilled using the dual-tube percussion hammer (dual-tube) method, air-rotary/casing-hammer (ARCH) method, sonic drilling, or the mud-rotary method. The shallow and intermediate monitoring wells will be drilled using the dual-tube, sonic, or ARCH methods. The extraction well (PEW-1) and cluster wells (PMW 17 and PMW 20) will be installed using the ARCH method. Drilling mud may be used during construction of the deeper monitoring wells or where collapsing of the borehole is encountered during drilling of the shallow and intermediate wells. Each drilling method is briefly described below. The determination of which drilling method to use will be made based on the overall technical approach and cost of subcontractor bids. Before drilling, the presence of underground utilities will be verified by Underground Service Alert (USA). A geophysical contractor will be called to survey drilling locations for which USA does not provide service. In addition, each boring will be started with a hand-auger or an air-knife to a depth of at least 5 feet to uncover any unknown or undetected utilities.

5.1.1.1 Dual-tube Percussion Hammer Method

The dual-tube drilling tooling consists of two nested drive casings advanced by a percussion hammer. Compressed air is circulated down the annulus between the two

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drive casings and up within the central drive casing (reverse air circulation), bringing the drill cuttings to the surface. Drill cuttings are discharged into a cyclone separator. The advantage to this method is that the borehole remains sealed by the drive casing at all times, thus reducing the production of groundwater during drilling. Drilling mud is not required to keep the borehole open. The method of air circulation also reduces the potential for compressed air intrusion into the adjacent formation compared to direct air rotary. Therefore, this method is expected to result in more representative discrete groundwater samples.

Discrete-depth groundwater samples will be collected with a disposable bailer from every permeable unit encountered or intervals of approximately every 15 feet, whichever is less. The samples will be used to construct a depth profile of relative VOC concentrations in groundwater that will be used to select the well screen depth interval. The data will be used to screen the depth range containing the highest relative VOC concentration, not to assess the actual VOC concentration. Potential effects on the aquifer immediately surrounding the borehole from intrusion of compressed air will be minimized by thorough development of each well, so that samples collected from the completed wells will provide accurate measurement of the local groundwater VOC concentrations. While the dual-tube method does have the potential to reduce the VOC concentrations in the in situ groundwater samples collected during drilling, the impacts are not anticipated to significantly affect decisions based on the data.

Because of sandier conditions in the Santa Fe Springs area at the southwestern end of the contaminant plume, the dual-tube drilling method may not be able to complete some or all of the borings, particularly the deeper borings, in this area. If the dual-tube drill rig cannot complete a boring because of problems with excessive groundwater production or heaving sands, the drilling will continue using mud-rotary drilling methods.

5.1.1.2 Air-Rotary Casing-Hammer Drilling (ARCH)

The ARCH method consists of a single drive casing advanced by a percussion hammer. Compressed air is circulated down the drill stem and up within the annular space between the drill stem and drive casing (direct air circulation). Drill cuttings are discharged into a cyclone separator. Drilling mud is not required to keep the borehole open. The borehole remains sealed by the drive casing during drilling. Discrete-depth groundwater samples can be collected using the same procedures as during dual-tube drilling. Potential effects on the groundwater around the borehole

will be minimized by thorough well development. Overall, this drilling method is similar to the dual-tube method; the drilling speed is generally slower. However, the major advantage of the ARCH method is that the drill rig can be converted to mud-rotary drilling if flowing sands are encountered. Such conversion is not available for dual-tube rigs.

5.1.1.3 Sonic Drilling

The sonic drilling technology employs the use of high-frequency mechanical vibration to advance the drill-string through unconsolidated, and to a limited extent consolidated, materials. The sonic drill rig uses an oscillator, or head, with eccentric weights driven by hydraulic motors, to generate high sinusoidal force in a rotating drill pipe. The frequency of vibration of the core bit can be varied to allow optimum penetration of subsurface materials. Sonic drilling uses water as the fluid medium as opposed to mud rotary, which uses mud. However, it can be done dry, without the use of drilling fluids.

Drilling is conducted using an inner casing (core barrel) equipped with a cutting shoe, followed by an outer casing. There are three types of cutting shoe: one that pushes the soil to toward the borehole wall, one that centralizes the soil into the core barrel, and one that is midrange. Either the midrange cutting shoe or the one that centralizes the soil will be used. When installing a 2-inch well, a 4-inch diameter inner core barrel and a 6-inch diameter outside casing are used. The core barrel advances 10 feet into the subsurface, followed by the outer casing. The core barrel is then removed from the borehole and the soil is sampled and bagged for preservation or for disposal. The core barrel is placed back into the borehole and pushed another 10 feet. An additional 10 foot length of outer casing is added to the outer casing that is in the ground and is advanced to meet the bottom of the core barrel. This process is continued until the total depth is reached. Sonic drilling generally produces only the cored sample, and may generate IDW water.

This technology has been used for the installation of shallow wells and cluster wells in multiple aquifers. Some of the locations where this technology was used include the Savana River Site and the McCormick and Baxter Superfund Site in Stockton, California.

5.1.1.4 Mud-Rotary Drilling

Drilling mud may be used during construction of the deeper monitoring wells or where borehole instability is encountered during drilling of the shallow and intermediate wells. Typically, mud-rotary methods are implemented to minimize borehole collapse and to assist in evacuating drill cuttings from the boreholes. Drilling mud is expected to reduce the possibility of cross contamination between groundwater zones, because it continuously invades the formation along the borehole walls and forms a low-permeability mud cake.

Drilling mud will consist of bentonite and water. No other additives will be permitted in the mud unless approved by the site hydrogeologist and EPA remedial project manager (RPM). The viscosity and density of the drilling mud will be tested periodically and maintained within the limits specified by the site hydrogeologist or engineer. Drilling mud will be forced down the drill pipe and out through ports in the drill bit utilizing the minimum quantity of mud required to evacuate drill cuttings from the borehole.

5.1.2 Well Testing

5.1.2.1 Lithologic Sampling

Borehole drill cuttings will be collected for description every 15 feet or at changes in lithology. Samples will be collected, the materials described and recorded on field boring logs by the field geologist and screened for organic contaminants with a photoionization detector. Following completion of the borings, samples will be disposed of with the rest of the drill cuttings. Downhole soil samples will not be collected for laboratory analysis.

5.1.2.2 Discrete Groundwater Sampling

In situ, discrete-depth profile samples will be collected during drilling. It is anticipated that the boring will be advanced approximately 50 feet into the saturated zone and samples taken about every 10 feet beginning at the water table (approximately 30 to 70 feet bgs). These sample depths are tentative; actual sample depths will be selected based on encountered lithology with the goal of sampling permeable (coarse grained) units. The total anticipated boring depth will be up to 180 feet bgs or less.

For planning purposes, it is assumed that 5 in situ groundwater samples will be collected at each well, for a total of 55 environmental field samples (not including duplicates, blanks, and QC samples). Samples will be analyzed for VOCs (the primary contaminants of concern), as discussed in Section 4. The sample results will need to be available in time for determining the well construction; an onsite mobile laboratory will be required.

In situ groundwater samples will be collected during drilling of the intermediate wells, beginning at the water table and extending every 10 to 20 feet to the total depth of the well. Additional samples may be collected at the discretion of the onsite geologist, with the intention to sample saturated sand horizons. For planning purposes, five groundwater samples are assumed for each well. Discrete-depth sampling is not anticipated during drilling of the extraction well (PEW1).

At each in situ groundwater sampling depth, when drilling using the dual-tube reverse circulation method or the ARCH method, the hole will be cleared of all drill cuttings, and all water in the hole will be evacuated by circulating compressed air. Air circulation will then be shut off to allow formation water to enter the drive casing. An in situ grab sample will be collected using a polyethylene bailer when the water level has recovered approximately 3 feet up within the drive casing. Only the discrete groundwater samples will be collected using a bailer. It is not practical, and it would be costly, to build temporary wells to collect these screening samples using low-flow sampling techniques. Disposable bailers will be used, so decontamination of the bailers is not required. A 100-pound-test monofilament fishing line will be attached to the bailer and used to lower and retrieve the bailer. A new piece of line will be used for each sample. The bailer will be lowered through the annulus between the nested drive casings, quickly pulled to the surface, and an adapter specifically designed for the delivery of VOC samples (low-flow device) will be used to transfer water from the bailer to prepreserved volatile organic analysis (VOA) vials.

As discussed for well installation procedures, the CPT rig will be used initially to evaluate groundwater conditions along the leading edge of the plume. If groundwater conditions from the samples collected meet the lateral extent criteria, those sample depths at which discrete groundwater samples could not be collected using the CPT rig, would be collected with either the Sonic or ARCH drill rigs.

When using a Sonic drilling system, a disposable bailer or alternative methods to collect depth-discrete water samples may be used. Alternative sampling methods

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may include using a Simulprobe® or downhole pump equipped with a packer (e.g., Boart Longyear Borehole Pumping System).

The samples will not be filtered in the field to avoid the loss of VOCs.

5.1.2.3 Geophysical Logging

Mud-rotary boreholes will be geophysically logged immediately upon completion of the pilot hole for each well. Results from the geophysical logging will help determine the casing depth and well screen interval. Geophysical logs to be performed will include electrical resistivity (long and short normal) and spontaneous potential. Additional logs such as caliper or natural gamma ray may be conducted if deemed necessary. Dual-tube, sonic, or ARCH boreholes cannot be geophysically logged prior to well installation. Wells installed in boreholes drilled by these methods may be logged using the induction and natural gamma methods, if deemed necessary. For the induction logging to be meaningful, the wells would have to be constructed entirely using polyvinyl chloride (PVC).

5.1.3 Well Construction

5.1.3.1 Single-Screened Wells

All single-screen monitoring wells will be constructed using 4-inch-diameter, flush-threaded Schedule 80 PVC casing, 15-feet of 4-inch-diameter (slotted) well screen (Figure 5-1). Wells installed in areas of high concentrations of chlorinated hydrocarbons (approximately over 1,000 µg/L) may be installed with Schedule 80 PVC casing and Type 316 stainless steel, continuous wire-wrapped, 0.020-inch slot well screens. Wells in low concentration zones will be installed with slotted (0.02-inch) PVC screens. Well construction details are summarized in Table 8.

5.1.3.2 Well Clusters

Well clusters will be constructed as multiple-completion wells with two to three casings (and screens) within a single borehole. The diameter of the casings and screens will be 2 inches. Figure 5-2 presents a typical multiple completion well diagram.

A 5-foot, Type 316 stainless steel or PVC, as appropriate, sediment trap with end cap will be installed below each screen. All monitoring well screens, except the shallow well screens, are anticipated to be 10 feet long; longer screens (20 or 25 feet) may need to be installed in thick permeable units. The shallow wells in the clusters will be equipped with a 15-foot screen to account for recent decreasing water levels. Centralizers will be used above and below the well screen and every 40 feet above the screen if the ARCH, sonic, or mud-rotary methods are used. Centralizers will not be needed if the well is constructed by the dual-tube method, as the casing is centered by the inner drive tube during well constructions.

5.1.3.3 Extraction Well (EW-1)

Extraction Well PEW1 will be installed with a 4-inch-diameter, Schedule 80 PVC casing, a 20-foot, 0.02- or 0.03-inch slot PVC or continuous stainless steel wire-wrap screen, and a 5-foot sediment trap.

The filter pack is anticipated to be No. 3 Monterey sand (or equivalent). A transition sand will be placed between the filter pack and the casing seal. The seal will be constructed using bentonite pellets or chips, which will be hydrated in place. The annular space above the seal will be filled with a cement-bentonite grout made with Portland cement and Aquaseal and/or Volclay grout (Aquaseal and Volclay are trade names for an inert, sodium bentonite). Bentonite seals will also be placed between the screen intervals of multiple completion wells.

Surface completions for each well will include flush-mount, traffic-rated well vaults set in concrete. Locks will be installed on each well to prevent vandalism and unauthorized access.

5.1.4 Well Development

Monitoring wells will be developed prior to groundwater sampling by bailing, surging, and pumping with a temporary high-capacity submersible pump. The development water will be contained and sampled for future treatment. The high-solids, turbid water removed from the well initially will be stored with the drilling fluids. Less turbid water removed during the later stages of the development will be stored in a separate container.

Well development will be performed after the grout used to construct the well has been allowed to set at least 48 hours. The extracted water pH, specific conductivity, turbidity, and temperature will be recorded during the development in a field logbook. Water clarity will be measured and recorded upon completion of the well development with a nephelometric turbidity unit (NTU) meter or equivalent. Development will continue until water quality parameters are stable.

The well development requirements are as follows:

- The suspended sediment content of the water is less than 0.75 milliliter per liter (mL/L), as measured in an Imhoff cone according to method E160.5.
- The water turbidity remains within a 10 NTU range for at least 30 minutes, and the water temperature, pH, and electrical conductivity (EC) have stabilized (temp = ± 1 degree C, pH = ± 0.1 units, and EC = $\pm 5\%$).
- No sediment shall remain in the bottom of the well.

All development equipment will be decontaminated prior to start. The development process will be purely mechanical (i.e., no chemical additives will be introduced into the well).

5.2 Land Surveying

Surveying activities will be conducted by a qualified surveying subcontractor licensed in the State of California. The following land surveying activities may be conducted at OU-2:

- Obtaining elevations of groundwater monitor wells and the extraction well survey points to an accuracy of 0.01 foot, referenced to msl.
- Establishing the elevation reference point for wells at the north rim of the top of the inner PVC well casing, and a permanent mark designating the elevation point. The ground surface elevation for each well and boring will be established to an accuracy of 0.01 foot.
- The horizontal datum of reference will be the North American Datum of 1983, 1991 adjustment (NAD91). Coordinates will be reported in the California State

Plane Coordinate System, North Zone, in U.S. survey feet. Horizontal control shall be established to 0.1 foot.

- The location of each well and sampling point will be tied into a permanent land monument (e.g., building corners).

5.3 Groundwater Sample Collection

Groundwater samples will be collected from the proposed EPA wells and the proposed extraction well. The following subsections describe sample collection procedures that will be used during the monitoring program described in this FSP. These procedures do not apply to the collection of the discrete groundwater samples during the well installation (Section 5.1.2.2).

5.3.1 EPA Wells

Proposed EPA monitoring wells will be purged and sampled using low-flow sampling techniques. As OSVOG has been directed to perform only one round of groundwater sampling, ARCADIS will perform the purging and sampling of these wells using dedicated, low-flow bladder pumps installed into each new well in compliance with the EPA's UAO. Low-flow groundwater sampling is the process of purging and sampling wells at low flow rates from within the well screen zone to minimize purging and improve sample quality. Low-flow groundwater sampling has the advantage of producing a representative groundwater sample with far less total well purge water than is obtained from conventional sampling of monitoring wells, in which three well volumes are purged prior to sampling. Samples collected by the low-flow sampling method have been shown to be more representative than samples collected by the three-well-volume purge method. Low-flow purging and sampling refers to the velocity with which water enters the pump intake, not necessarily to the flow rate of water discharged at the surface. Water-level drawdown provides the best indication of the stress imparted by a given flow rate for a given hydrological situation. The proper flow rate for each well will be based on the ability to establish a low-flow rate at an acceptable level of drawdown (0.2 to 0.3 foot), and with minimum fluctuations of that water level during pumping. To achieve this, the pump will be initially operated at the minimum flow capacity of the pump, then the flow rate will be gradually increased until some initial drawdown is observed. The flow rate will then be reduced slightly to achieve a stabilized purge rate for the well. It is anticipated that flow rates on the order of 0.1 to 0.5 liter per minute (L/min) will be achieved. However, the flow rate will not exceed 1.0 L/min in any case. Careful,

continuous measurement of field parameters including pH, temperature, specific conductance, dissolved oxygen (DO), oxidation-reduction potential (ORP) will be used to assess when purged water has reached equilibrium. The time interval between readings will be dictated by the stabilized pumping rate for each well (typically between 1 and 3 minutes). An initial change in the measurements typically indicates that water is being drawn from a different source ("active" versus "stagnant" water). Stabilization of these parameters would indicate that the water is coming from a steady-state source (the formation immediately surrounding the well screen near the pump intake). Equilibrium conditions are sometimes achieved after extraction of less than 10 liters, with 4 to 8 liters being the average reported in published studies. Therefore, the volume of water removed by this method during purging will be considerably less than with conventional purging techniques.

Accurate measurement of the field parameters will require a flow-through cell or other means to ensure that the purge water is continuously monitored. Although the flow-through cell is the preferred method, an acceptable alternate method is placing the probes in a small bucket or beaker that continuously overflows, with the discharge tubing placed near the probes, and covering the beaker or bucket with clear plastic film (such as Saran Wrap®). Each well will be pumped until the measured field parameters (temperature, pH, turbidity, and EC) have stabilized within 10 percent over three successive readings prior to collecting samples.

5.3.2 Field Parameters Measurement

A conventional pH meter with a combination gel-filled electrode or equivalent will be used for field pH and temperature measurements (digital readout). A combination conductivity-temperature-salinity-ORP meter will be used for specific conductance and oxidation-reduction potential measurements. Turbidity measurements will be made with a digital readout turbidity meter (readout in NTU). Samples for field measurements will be collected in a beaker used solely for field parameter determinations. All probes will be thoroughly rinsed with distilled water prior to, and between, any measurements at each well.

When using the low-flow sampling technique, flow-through cells will be used to measure the field parameters. Low-flow rate purging, sampling, and field parameter measurement of this nature is often referred to as "micro-purge" sampling and results in quicker sampling, generation of less purge water, and more representative sampling results.

Equipment used to measure field parameters will be maintained and calibrated according to manufacturer's specifications. At a minimum, calibration will occur at the start of each day, and will be recorded in the field logbook along with the equipment serial number.

5.4 Sample Containers and Preservatives

Sample container requirements and preservation methods for each analysis are summarized in Table 4 (previously presented). Sample containers will be laboratory-provided or purchased with certificates of cleanliness from approved laboratory product suppliers.

5.4.1 Groundwater

Samples to be analyzed for VOCs will be collected in three 40-mL glass VOA vials. A sufficient amount of 1:1 hydrochloric acid (HCl) will be placed inside the vials to lower the sample pH to less than 2.

- Samples will be tested to ensure that sufficient preservatives have been added (e.g., a test bottle or vial), and the test bottles will be filled and checked to determine if sufficient preservatives have been added using the following (or similar) steps:
 - Add preservative to test sample vial;
 - Fill with sample, cap, and invert to ensure mixing;
 - Test the pH to determine if less than 2 is achieved; if so, add same amount of preservative to the actual sample vial and collect the sample; discard the test vial; and
 - Add more preservative and repeat until pH less than 2 is achieved.

Many laboratories provide pre-acidified VOA-sample vials and these will be used, if available from the laboratory. A field check of the amount of preservative contained in the pre-acidified VOA vials will be conducted similar to the approach described above to confirm that sufficient preservative has been provided. If the pre-acidified VOA vials do not contain enough preservative to achieve the proper pH (<2), additional preservative will be added to the vial and repeated until the proper pH is achieved. This additional amount of preservative will then be added to each sample container prior to collection of samples.

The vials will be filled so that no headspace is present after sample collection. Filled containers will be checked by inverting the vial and tapping to reveal any air bubbles. If air bubbles are present, containers will be emptied, re-acidified, and refilled. If, after several attempts at sample collection, air bubbles remain, the sample will be described in the field notebook as an "aerated sample."

VOA vials will be cooled to 4°C and stored away from sunlight prior to shipping by immediately placing the full sample bottle into an iced cooler. The maximum analytical holding time for VOCs will be 14 days.

Samples for dissolved metals analysis will be passed through a 0.45-micron filter immediately after collection. The samples will subsequently be preserved by addition of nitric acid to a pH less than 2. The pH paper should not be inserted into the bottle as the dyes used contain metals. Samples will be placed into 1-liter polyethylene bottles and cooled to 4°C. The maximum analytical holding time for dissolved metals will be 6 months. If the groundwater samples contain enough suspected solids that filtration in the field is slow enough to delay sampling, then the samples will be submitted unfiltered to the lab, and the lab will be asked to filter the samples immediately upon receipt.

Samples for hexavalent chromium will be placed in one 125-mililiter (mL) polyethylene bottle and chilled to 4°C. The analytical holding time for this method will be 24 hours. Samples collected for perchlorate will be placed in one 250-mL polyethylene bottle or together with nitrate in one 250-mL polyethylene bottle and cooled to 4°C. The maximum analytical holding time will be 28 days for perchlorate.

Samples for cyanide will be placed in one 500-mL polyethylene bottle, preserved with sodium hydroxide (sample pH>12) and chilled to 4°C. The analytical holding time for this method will be 14 days.

Samples collected for NDMA will be placed in 1-liter amber glass bottles and cooled to 4°C. Two liters will be collected for this analysis, and the maximum analytical/contract holding time for NDMA will be 7 days prior to extraction and 40 days following extraction.

Samples for 1,4-dioxane analysis will be collected in unpreserved 1-liter glass amber bottles and cooled immediately after sampling to 4°C. The analytical holding time for this analysis is 7 days prior to extraction and 40 days following extraction.

Samples for 1,2,3-TCP analysis will be collected in three 40-mL glass VOA vials acidified using HCl to lower the sample pH to less than 2. The VOC vials will be cooled immediately after sampling to 4°C. The analytical holding time for this analysis is 14 days.

Samples for SVOC analysis will be collected in two unpreserved 1-liter glass amber bottles and cooled immediately after sampling to 4°C. The analytical holding time for this analysis is 7 days prior to extraction and 40 days following extraction.

Samples for nitrate and nitrite analysis will be collected in unpreserved 0.5-liter polypropylene bottles and cooled immediately after sampling to 4°C. The analytical holding time for this analysis is 48 hours.

Samples for TOC analysis will be collected in unpreserved 40-mL glass VOA vials acidified using HCl to lower the sample pH to less than 2. The samples will be cooled immediately after sampling to 4°C. The analytical holding time for this analysis is 28 days.

5.4.2 Investigation Derived Waste

ARCADIS and OSVOG are currently evaluating one or more possible staging areas where investigation-derived waste can be stored pending disposal. ARCADIS will notify EPA once these locations are determined and access agreements arranged.

Samples of drill cuttings from roll-off bins will be collected using 6-inch long, 2-inch diameter brass sleeves, capped with teflon tape and plastic caps, and cooled to 4°C. The maximum holding time for TPHg, TPHd, and VOCs is 10 days. The maximum holding time for TTLC metals is 6 months (28 days for mercury). The maximum holding times for flashpoint is 28 days.

One drilling fluid sample per each water-holding tank will be collected and submitted for laboratory analysis. Each sample will be collected using a new, disposable polyethylene bailer and inert rope to fill the appropriate sample containers. After collecting drilling fluid from near the bottom of the temporary storage container, the liquid will be slowly poured from the bailer into the sample container to minimize agitation and to prevent overfilling of the container. High liquid-content drilling mud holding times are identical to drill cutting and low liquid-content holding times, except that the samples will be collected in two 1-liter amber glass bottles and cooled to 4°C.

Monitoring well development and purge water from each well will be stored onsite in temporary storage containers (tanks or drums) pending results from sampling. Each well development water sample will be collected using a new, disposable polyethylene bailer and inert rope to fill the appropriate sample containers (e.g., acidified, 40-mL glass vials for VOC analysis). After collecting water from mid-depth in the temporary storage container, the water will be slowly poured from the bailer into the sample containers to minimize agitation and to prevent overfilling of the containers. Sample container requirements and analytical holding times are described above.

5.5 Decontamination

Field equipment used during groundwater sampling and aquifer testing activities will be decontaminated using the following procedure:

- Wash with non-phosphate detergent;
- Rinse with methanol (groundwater sampling equipment only);
- Rinse with deionized water;
- Rinse with high-performance liquid chromatography (HPLC)-grade water (groundwater sampling equipment only); and
- Air-dry.

When a mobile submersible pump is used to sample wells without dedicated pumps, the following procedure will be used to decontaminate the pump and discharge tubing between wells:

- Submerge the pump and full length of discharge tubing in a non-phosphate detergent bath;
- Operate the pump, while submerged, to circulate detergent through the pump mechanism and discharge tubing. The pump will be operated long enough to allow a minimum of five tubing volumes to pass through the pump and discharge tubing;
- Remove the pump and tubing from the detergent bath and pump any remaining detergent back into the detergent bath or to waste. Rinse the pump and tubing with methanol. Submerge the pump and the full length of discharge tubing in a potable water bath;

- Operate the pump, while submerged, to circulate potable water through the pump mechanism and discharge tubing, and flush out remaining detergent. The pump will be operated long enough to allow a minimum of five tubing volumes to pass through the pump and discharge tubing;
- Remove the pump and tubing from the potable water bath and pump any remaining rinse water back into the potable water bath or to waste. Submerge the pump and the full length of discharge tubing in a deionized water bath;
- Operate the pump, while submerged, to circulate deionized water through the pump mechanism and discharge tubing, and flush out remaining potable water. The pump will be operated long enough to allow a minimum of five tubing volumes to pass through the pump and discharge tubing; and
- Remove the pump and tubing from the deionized water bath and pump any remaining deionized water back into the deionized water bath or to waste.

The detergent, potable water, and deionized water baths will be emptied as IDW water and replenished daily. In general, wells will be sampled in an order progressing from least VOC contamination to highest VOC contamination, to prevent cross-contamination of wells with minimal or undetectable VOC concentrations. As an alternative to the above decontamination procedure, new disposable discharge tubing may be used at each well, with the pump mechanism decontaminated by submersion and pumping within detergent, potable water, and deionized water baths, consecutively.

5.6 Containment and Disposal of IDW

The types of wastes that may be derived from the RI field activities include drill cuttings and drilling fluids from drilling activities, water from developing and purging monitoring wells before sampling, protective clothing, and trace amounts of decontamination rinsate.

5.6.1 Drill Cuttings and Drilling Fluids

Drill cuttings and drilling fluids will be sampled and analyzed to assess whether they are hazardous. To expedite disposal of wastes, the laboratory will provide quick turnaround of waste analyses results. If testing indicates that none of the quantified VOCs are above federal and state regulatory levels and that the pH, flashpoint, and

TPH results are acceptable (i.e., the wastes are not corrosive or flammable and contain petroleum hydrocarbons below landfill limits), the cuttings and solidified drilling mud wastes will be classified as nonhazardous and disposed of at a local Class III landfill.

If, however, the drill cuttings are classified as hazardous waste, then the bins will be hauled to a hazardous waste disposal facility approved to receive Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) wastes. Free liquids may be removed from the drill cuttings by solidification at each well site. The solidification process would involve pumping all free liquids off the drill cuttings and allowing the drill cuttings to solidify through natural evaporation.

If nonhazardous, spent drilling mud will be disposed of at a local facility specializing in drilling mud disposal. Free liquids may be removed from the drilling mud by solidification at each well site. The solidification process would involve pumping all free liquids off the drill cuttings and allowing the drill cuttings to solidify through natural evaporation. Nonhazardous drilling mud may be sent to a recycler for use in plugging oil wells or to a landfill for use as landfill cover material. If, however, the drilling mud is classified as hazardous waste, the material may be hauled to a hazardous waste disposal facility approved to receive CERCLA wastes or to an approved recycling facility.

5.6.2 Extracted Water

Groundwater extracted during the well development will be stored in tanks or drums onsite, depending on quantity. Low-flow sampling of monitoring wells will potentially produce small quantities of VOC-contaminated water. This water will be temporarily stored in 55-gallon drums, properly labeled, and transported to a central location at the site. An effort will be made to separate water containing VOCs only from water containing dioxane, perchlorate, NDMA, metals, cyanide, and hexavalent chromium.

A sample will be taken from each tank (a composite sample from drums) and sent to a laboratory for VOC analysis. ARCADIS proposes to contract a hazardous materials contractor to collect waste water using a vacuum truck and disposing of the liquids at a licensed treatment storage and disposal facility.

5.6.3 Clothing

All drilling and sampling activities included in this plan are anticipated to be performed in modified Level "D" personal protective equipment. Disposable protective clothing generated during the performance of the work will be contained in Department of Transportation-approved 55-gallon drums (i.e., 17H). The drums will be sealed and labeled to indicate site name, drilling locations, and what is being stored. If the drill cuttings and drilling mud are determined to be nonhazardous, the protective clothing will be disposed of at a local Class III landfill. If, however, the drill cuttings and/or drilling mud are classified as hazardous waste, then the drums will be hauled to a hazardous waste disposal facility approved to receive CERCLA wastes.

5.7 Sample Management Procedures and Documentation

The following section discusses various sample management procedures that will be followed during the performance of field activities. Included in these sections are procedures for sample packaging and transportation, sample labeling, and sample documentation.

5.7.1 Sample Packaging and Shipment

The sample packaging and shipment procedures are outlined below.

5.7.1.1 Preparation of Sample Coolers

The following steps will be used to prepare the sample coolers:

1. Remove all previous labels used on the cooler.
2. Seal all drain plugs with tape (inside and outside).
3. Place a cushioning layer of recyclable cornstarch popcorn or bubble wrap at the bottom of the cooler.
4. Line the cooler with a large plastic bag to contain samples.
5. Double-bag all ice in resealable plastic bags and seal.

5.7.1.2 Packing Samples in Coolers

The following steps will be used to pack the samples in coolers:

1. Place the chain-of-custody (COC) form in a resealable bag and tape to the underside of the cooler lid.
2. Make sure that all glass sample containers are packaged in bubble wrap, secured with clear mailing tape.
3. Place samples in an upright position in the cooler.
4. Place ice on top of and between the samples.
5. Fill the void space between samples with recyclable cornstarch popcorn, double-bagged ice, or bubble wrap.
6. Custody seal large plastic bag containing samples and packing material.

5.7.1.3 Closing and Shipping of Cooler

Coolers will be packed with packing material surrounding the bottles to prevent breakage during transport. Ice will be sealed in plastic bags to prevent melting ice from soaking the packing material. Sample documentation will be enclosed in sealed plastic bags taped to the underside of the cooler lid. Coolers will be secured with packing tape and custody seals as described in the steps below.

1. Tape the cooler lid with strapping tape, encircling the cooler several times.
2. Place COC seals on two sides of the lid (one in front and one on the side).
3. Place "This Side Up" arrows on the sides of the cooler.

The coolers will then be delivered to the appropriate laboratory by the sampling team or by overnight courier the day of sample collection. Each day's sample shipment will be reported to the laboratory client manager, PM and PC. For Friday shipments, the laboratory client manager must be contacted prior to 12:00 noon to coordinate sample receipt. Samples will only be shipped on Friday if the laboratory provides assurance that analytical holding times will not be exceeded.

5.7.2 Sample Labeling

The following information will be written on each sample container label with a permanent marker and will be covered with clear plastic tape:

- Sample location number;
- Type of analysis requested;

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- Preservative used; and
- Date and time collected.

Immediately following sample collection, the filled sample containers with completed labels will be sealed with custody seals (described below), placed in plastic resealable bags, and placed in a cooler containing ice. VOA vials (three vials per sample) will be wrapped together in bubble wrap, secured with tape, and placed into labeled, plastic resealable bags. All other glass bottles will be bubble-wrapped, and placed into labeled plastic resealable bags.

For large containers, custody seals will be placed over the lids of each sample container. For small containers (e.g., VOA vials), custody seals will be placed across the opening of the bag containing the containers to prevent opening of the bag.

An example sample identification (sample ID) with an explanation follows:

OC2-MW20A-W-0-54	
OC2	Prefex "OC" stands for Omega Chemical and "2" designates the operable unit (1 or 2) the sampling was conducted for; this sampling effort is conducted entirely for OU2.
MW20A	The location (well name) where the sample was taken.
W	Sampled medium: W for water or groundwater, S for soil or drill cuttings.
0	Designation of sample type: 0 – primary sample 1 – field duplicate 2 – field blank 3 – equipment blank (rinsate) 4 – trip blank 5 – MS/MSD 6 – regulatory split
54	Sequential number denoting the order in which the sample was collected

The code for regulatory split samples is included in the explanation above because they may potentially be used under this work assignment. They are not, however, part of the current effort covered by this FSP.

The IDW sample IDs will be labeled similarly, e.g., OC2-IDW-W-0-55 for waste water, OC2-IDW-S-0-56 for waste soil (drill cuttings).

5.7.3 Sample Documentation

5.7.3.1 Field Notebooks

Bound and numbered logbooks will be used to record all sampling information. Information in the logbooks will include, at a minimum, the following:

- Name and title of the recorder, and date and time of entry;
- General description of weather conditions;
- Personnel involved with the activities;
- Photographic log, if appropriate;
- Sampling location and description;
- Location of duplicate and QC samples, date and time of collection, parameters to be analyzed, sample ID numbers, blank ID numbers, whether or not split samples were collected, and if so, for whom;
- Condition of well being sampled;
- Serial number and calibration of field instruments;
- Record of parameter values obtained during purging;
- Time of sampling;
- Sample description;
- Shipping addresses for laboratories;
- Names of visitors, their associations, and purpose of visit;
- Unusual activities such as departures from planned procedures; and
- References to important telephone calls.

All logs will be completed, signed, and dated by the recorder. All information recorded in the logs will be written with waterproof ink. Corrections will be made by crossing out the error with a single horizontal line, initialing the correction, and entering the correct information. Crossed-out information must be readable.

5.7.3.2 Chain-of-Custody Forms

Chain-of-custody procedures will be used to maintain and document sample collection and possession. After sample packaging, the following one or more of the COC paperwork forms will be completed, as necessary, for the appropriate samples:

- Chain-of-Custody Record
- Overnight shipping courier air bill

Completed field QA/QC summary forms will be sent to the QAO at the conclusion of each sampling event.

5.8 Quality Control Samples

The QC samples will be collected or prepared to assist in determining data reliability. These QC samples include equipment blanks, field duplicates, field blanks, and laboratory QC samples (for MS and MSDs). The QC samples are normally collected from locations that are suspected to be of moderate contamination. The QC samples will be collected immediately following, and using the same procedures as, the collection of the target sample.

5.8.1 Equipment Blanks

Equipment blanks are collected to verify that contamination is not introduced to samples through the repeated use of sampling equipment at different sample locations. One equipment blank per sampling event will be collected from a submersible pump used to sample OU-1 wells. These wells have dedicated pump tubing, but not dedicated pumps. The pump will be decontaminated using the procedures outlined in Section 5.5 and a rinsate sample will be collected and analyzed for VOCs. Section 4 provides the number of equipment blanks expected during the scheduled events.

5.8.2 Field Duplicates

The field duplicate is an independent sample collected as close as possible to the original sample from the same source and is used to document sampling precision. Field duplicates will be labeled and packaged in the same manner as other samples so that the laboratory cannot distinguish between samples and duplicates. Field duplicates will be collected by alternately filling sample and sample duplicate

containers at a location of known or suspected contamination. Each duplicate will be taken using the same sampling and preservation method as other samples. An attempt will be made to collect duplicate samples from monitoring wells that are known or suspected of containing the chemicals that are being analyzed. Section 4 of this FSP presents the number of field duplicates expected to be collected during the scheduled sampling events.

5.8.3 Field Blanks

The field blanks are collected to verify that contamination is not introduced to samples during collection, handling, or shipping of the samples. They will be prepared by pouring blank water directly into the sample bottles (true field blanks) or by pouring blank water over or through decontaminated sampling equipment (equipment blanks). Commercially prepared HPLC water will be used for organic analyses and reagent-grade deionized water for inorganic analyses using the same preservation methods and packaging and sealing procedures used during collection of groundwater samples. Field blanks will be prepared and labeled in the same manner as the field samples and sent "blind" to the laboratory. During groundwater sampling a field blank will be collected, at a minimum, at the first sampling location each day, and every 10 samples thereafter (or 10 percent of the primary samples). A blank sample will be submitted daily for VOCs analysis. Section 4 of this FSP presents the number of and type of blank samples expected to be collected during the scheduled sampling events.

5.8.4 Laboratory QC Samples

Laboratory QC samples will be collected to perform MS and MSD analyses. An MS is an aliquot of a sample spiked with a known concentration of target analytes and provides a measure of the method accuracy. The MSD is a laboratory split sample of the MS, and is used to determine the precision of the method.

Twice the normal water volume will be collected for laboratory QC samples. Laboratory QC samples will be labeled as such on sample bottles and paperwork. The MS/MSDs will be collected at the discretion of the field crew, at a frequency of one in every 20 consecutively collected samples or one per week, whichever is greater. Section 4 of this FSP presents the number of MS/MSDs expected during the scheduled sampling events.

5.8.5 Trip Blanks

Trip blanks will be used to assess the potential introduction of contaminants from sample containers or during the transportation and storage procedures. A trip blank consists of a VOC vial filled in the laboratory with HPLC-grade water, transported to the sampling site, handled like an environmental sample, and returned to the laboratory for analysis. Trip blanks are not opened in the field, are prepared only when VOC samples are collected, and analyzed only for VOCs. Although collection of trip blanks is not expected during the scheduled events, as previously discussed, trip blanks will be prepared and maintained for all post-well-installation groundwater sampling events. The trip blanks will only be analyzed if contamination is found in field or equipment blanks.

5.8.6 Temperature Blanks

Temperature blanks will be included with each cooler shipment containing samples (regardless of targeted analysis) sent to the laboratory. A temperature blank consists of a VOC sample vial filled in the field with de-ionized water, handled like an environmental sample, and returned to the laboratory for analysis. The temperature blank provides a means of verifying that samples have been maintained at the proper temperature (4 °C) following collection and during transport to the laboratory.

6. Health and Safety Plan

The Health and Safety Plan (HSP) for the activities described in this FSP is provided in Appendix A. A hospital location map is included in the HSP.

7. References

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Tables

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Table 1. Location and Rationale for Groundwater Monitoring Wells

Well Name	Location	Latitude/Longitude	Rationale
PEW-1	On Burke Street, east of Sorensen Avenue, about 30 feet east of MW08 well cluster.	33.961967 -118.060341	Pumping well for an aquifer test within an apparent zone of preferential contaminant migration. Screened approximately between 60 and 80 feet bgs to target the same depth zone as MW08B.
PMW12	On Baldwin St. 500 feet west of Whittier Blvd. Proposed Alternate: in private driveway just south of the Tool & Jig Plating Company	33.972027 -118.046844	Provide information on contaminant distribution in an area that may have been impacted by a source other than Omega.
PMW13	About 500 feet southwest of the intersection of Putnam St. and Pacific St.	33.969711 -118.047028	Provide information on contaminant distribution that likely originated from a source other than Omega.
PMW14	On Washington Blvd., about 250 feet west of intersection with Lambert Rd.	33.967197 -118.049446	Provide data in high-concentration area of the plume to verify the plume continuity and vertical contaminant distribution, and to characterize the lithology down-gradient of the Omega site.
PMW15	In the driveway between two industrial buildings, approximately 450 feet west-southwest of Byron Road, south of Riviera Rd.	33.963806 -118.052826	Verify the plume continuity in an area that contains elevated VOC concentrations downgradient of the Omega site..
PMW16	On Altamar Place, about 310 feet southeast of Diçe Road	33.956223 -118.065605	Characterize the distribution of contamination within the plume. Well is located upgradient of a potential separate VOC source other than Omega.
PMW17	In the southeast-bound right lane, about 250 feet southeast of the intersection of Pike Dr. and Pacific St.	33.953194 -118.068703	3-well cluster to characterize and monitor vertical extent of contamination at a location downgradient of a high concentration area away from the Omega Site, and provide lithologic and head data.
PMW18	In the northeast-bound right lane of Santa Fe Springs Rd., just southwest of the intersection with Ann Street.	33.954662 -118.054810	Characterize lateral extent of the plume upgradient of WDI. Cluster well.
PMW19	Just west of the intersection of Bell Ranch Rd. and McCann Dr. Alternate Location: In the south-bound right lane of Santa Fe Springs Rd about 485 feet south of the centerline intersection of McCann Dr..	33.946762 -118.064453 33.945415 -118.063797	Characterize leading edge of the contaminant plume.
PMW20	In the north-bound right lane of Geary Ave., 500 feet south of intersection with Matern St. Alternate Location: In the north-bound right lane of Heritage Park Drive just south of Telegraph Rd.	33.944519 -118.074913 33.942043 -118.074059	Three well cluster to characterize vertical extent of contamination, and provide lithologic and head data.

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Table 1. Location and Rationale for Groundwater Monitoring Wells

Well Name	Location	Latitude/Longitude	Rationale
PMW21	On Hamden St., 250 feet east of Pioneer Blvd.	33.947693 -118.078735	Characterize leading edge of the contaminant plume.
	Alternate Location: In the southeast bound right lane of Telegraph Rd, about 500 southeast of the intersection with Pioneer Rd.	33.944496 -118.079422	
PMW22	At intersection of Arlee Ave. and Fredson St., 1,500 feet west of intersection of Norwalk Blvd. and Pike Dr.	33.954453 -118.077156	Characterize leading edge of the contaminant plume.
	Alternate Location #1: In the north parking lot of an industrial building located at	33.952477 -118.076904	
	Alternate Location #2: In the southeast-bound right lane of Los Nietos Road about 1,100 feet northwest of the intersection with Norwalk Blvd.	33.959343 -118.074211	
PMW23,	Approximately 740 feet southeast (bearing 31.689111) of the intersection of Sornesen Avenue and Burke Street	33.960381 -118.059364	Evaluate the concentration of contaminants upgradient of the McKesson and LA Chemical sites.

Note:

Latitude/Longitude are approximate, and taken from www.LandVoyage.com

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Table 2. Data Needs and Uses

Compound	Uses/Decisions	Applicable Regulatory Limit (µg/L)	Applicable ARAR (1)	California DHS DLR (µg/L) (2)	Additional Regulatory Limits (µg/L)
TCL Volatile Organic Compounds					
Acetone	Exceedances with respect				
Benzene	to federal and state drinking	1	CA Primary MCL ^(A)	0.5	0.15 ^(E)
Bromodichloromethane	water standards, and state	100	USEPA Primary MCL ^(C)	0.5	2.5 ⁽¹⁾ ; 100-proposed ^(A)
Bromoform	action levels.	100	USEPA Primary MCL ^(C)	0.5	45 ⁽¹⁾ ; 100-proposed ^(A)
Bromomethane	Evaluate water treatment	500	CA Proposition 65 Regulatory Level ⁽¹⁾	0.5	
n-Butylbenzene	system design.	260	CA DHS State Action Level (F)		
sec-Butylbenzene	Evaluate remedial action	260	CA DHS State Action Level (F)		
Carbon disulfide	performance.	160	CA DHS State Action Level (F)		
Carbon tetrachloride		0.5	CA Primary MCL ^(A)	0.5	0.1 ^(E)
Chlorobenzene		100	USEPA Primary MCL ^(C)		50 ^(H)
Chloroethane		16	Other Taste and Odor ^(H)	0.5	100 ⁽¹⁾
Chloroform					
Chloromethane			No Applicable ARAR		
2-Chlorotoluene		140	CA DHS State Action Level (F)		
4-Chlorotoluene		140	CA DHS State Action Level (F)		
Cyclohexane					
Dibromomethane					
Dibromochloromethane					
Dibromochloropropane (DBCP)		0.2	USEPA Primary MCL ^(C)		0.05 ⁽¹⁾
1,2-Dibromoethane		0.05			0.1 ⁽¹⁾
1,2-Dichlorobenzene		600	CA DHS State Action Level (F)	0.5	600 ^(E)
1,3-Dichlorobenzene		600	CA DHS State Action Level (F)	0.5	600 ^(F)
1,4-Dichlorobenzene		5	CA Primary MCL ^(A)	0.5	6 ^(E)
Dichlorodifluoromethane		1,000	CA DHS State Action Level (F)		

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Table 2. Data Needs and Uses

Compound	Uses/Decisions	Applicable Regulatory Limit (µg/L)	Applicable ARAR (1)	California DHS DLR (µg/L) (2)	Additional Regulatory Limits (µg/L)
1,1-Dichloroethane	Exceedances with respect to federal and state drinking water standards, and state action levels. Evaluate water treatment system design. Evaluate remedial action performance.	5	CA Primary MCL ^(A)	0.5	3 ^(E)
1,2-Dichloroethane		0.5	CA Primary MCL ^(A)	0.5	0.4 ^(E)
1,1-Dichloroethylene		6	CA Primary MCL ^(A)	0.5	7 ^(C) ; 10 ^(E)
cis-1,2-Dichloroethylene		6	CA Primary MCL ^(A)	0.5	70 ^(C)
trans-1,2-Dichloroethylene		10	CA Primary MCL ^(A)	0.5	100 ^(C)
Dichloromethane (Methylene Chloride)		5	CA/USEPA Primary MCL ^{(A) (C)}	0.5	4 ^(E)
1,2-Dichloropropane		5	CA/USEPA Primary MCL ^{(A) (C)}	0.5	0.5 ^(E)
2,2-Dichloropropane					
1,1-Dichloropropene					
1,3-Dichloropropene		0.5	CA Primary MCL ^(A)	0.5	
cis-1,3-Dichloropropene		0.5	CA Primary MCL ^(A)	0.5	0.2 ^(E)
trans-1,3-Dichloropropene		0.5	CA Primary MCL ^(A)	0.5	0.2 ^(E)
Ethane					
Ethene					
Ethylbenzene		300	CA Primary MCL ^(A)	0.5	700 ^(C) ; 300 ^(E) ; 29 ^(H)
Hexachlorobutadiene					
2-Hexanone					
Isopropylbenzene (Cumene)		770	CA DHS State Action Level (F)	0.5	
Methane					
Methyl acetate					
Methyl ethyl ketone		8400	Other Taste and Odor ^(H)	5	
Methyl isobutyl ketone (MIBK)		120	CA DHS State Action Level (F)		1300 ^(H)
Methylcyclohexane					
Napthalene		170	CA DHS State Action Level (F)		
n-Propylbenzene		260	CA DHS State Action Level (F)		

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Table 2. Data Needs and Uses

Compound	Uses/Decisions	Applicable Regulatory Limit (µg/L)	Applicable ARAR (1)	California DHS PLR (µg/L) (2)	Additional Regulatory Limits (µg/L)
Styrene	Exceedances with respect	100	CA/USEPA Primary MCL ^{(A) (C)}	0.5	11 ^(H)
1,1,2,2-Tetrachloroethane	to federal and state drinking	1	CA Primary MCL ^(A)	0.5	0.5 ^(E) ; 1.5 ^(I)
Tetrachloroethylene (PCE)	water standards, and state	5	CA/USEPA Primary MCL ^{(A) (C)}	0.5	0.06 ^(E)
Toluene	action levels.	150	CA Primary MCL ^(A)	0.5	42 ^(H) ; 1,000 ^(C)
1,2,3-Trichlorobenzene	Evaluate water treatment				
1,2,4-Trichlorobenzene	system design.	5	CA Primary MCL ^(A) /CA PHG ^(E)	0.5	70 ^(C)
1,1,1-Trichloroethane	Evaluate remedial action	200	CA/USEPA Primary MCL ^{(A) (C)}	0.5	
(1,1,1-TCA)	performance.				
1,1,2-Trichloroethane	↓	5	CA/USEPA Primary MCL ^{(A) (C)}	0.5	5 ^(I)
Trichloroethylene (TCE)		5	CA/USEPA Primary MCL ^{(A) (C)}	0.5	0.8 ^(E)
Trichlorofluoromethane (Freon 11)		150	CA Primary MCL ^(A)	5	700 ^(E)
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)		1,200	CA Primary MCL ^(A)	10	4,000 ^(E)
1,2,4-Trimethylbenzene		330	CA DHS State Action Level (F)		
1,3,5-Trimethylbenzene		330	CA DHS State Action Level (F)		
Vinyl chloride		0.5	CA Primary MCL ^(A)	0.5	0.05 ^(E) ; 2 ^(C)
Xylene(s)		1,750	CA Primary MCL ^(A)	1	17 ^(H) ; 10,000 ^(C)
Additional Volatiles					
Methyl tert-butyl ether (MTBE)		13	CA Secondary MCL ^(B)	3	13 ^(E)

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Table 2. Data Needs and Uses

Compound	Uses/Decisions	Applicable Regulatory Limit (µg/L)	Applicable ARAR (1)	California DHS DLR (µg/L) (2)	Additional Regulatory Limits (µg/L)
TCL Semivolatile Organic Compounds					
Acenaphthene	Exceedances with respect to federal and state drinking water standards, and state action levels. Evaluate water treatment system design. Evaluate remedial action performance.	0.2	CA/USEPA Primary MCL ^{(A) (C)}	0.1	0.004 ^(E)
Acenaphthylene					
Acetophenone					
Aniline (Phenylamine)					
(Aminobenzene)					
Anthracene					
Benzaldehyde					
Benzoic Acid					
(Carboxybenzene)					
Benzo(a)anthracene					
Benzo(a)pyrene					
Benzo(b)fluoranthene					
Benzo(g,h,i)perylene					
Benzo(k)fluoranthene					
Benzyl Alcohol					
(Phenylmethanol)					
1,1'-Biphenyl					
Bis(2-chloroethoxy)methane					
Bis(2-chloroethyl)ether					
Bis(2-chloroisopropyl)ether					
4-Bromophenyl-phenyl ether					
Butylbenzyl phthalate (BBP)					
Caprolactam					
Carbazole					
4-Chloro-3-methylphenol					
4-Chloroaniline					

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Table 2. Data Needs and Uses

Compound	Uses/Decisions	Applicable Regulatory Limit (µg/L)	Applicable ARAR (1)	California DHS DLR (µg/L) (2)	Additional Regulatory Limits (µg/L)
2-Chloronaphthalene	Exceedances with respect to federal and state drinking water standards, and state action levels.				
2-Chlorophenol					
4-Chlorophenyl-phenyl ether					
Chrysene	Evaluate water treatment system design.	400	CA/USEPA Primary MCL ^{(A) (C)}	5	200 ^(E)
Di(2-ethylhexyl)adipate		4	CA Primary MCL ^(A)	3	6 ^(C) , 12 ^(E)
Di(2-ethylhexyl)phthalate	Evaluate remedial action performance.				
dibenz(a,h)anthracene					
Dibenzofuran (Diphenylene oxide)	↓				
3,3'-Dichlorobenzidine					
2,4-Dichlorobenzidine					
2,4-Dichlorophenol					
Diethyl phthalate (DEP)					
Dimethyl phthalate					
2,4-Dimethylphenol		100	CA DHS State Action Level (F)		
4,6-Dinitro-2-methylphenol					
2,4-Dinitrophenol					
2,4-Dinitrotoluene					
2,6-Dinitrotoluene					
Di-n-butylphthalate (Dibutyl phthalate)					
Endothall		100	CA/USEPA Primary MCL ^{(A) (C)}	45	580 ^(E)
Fluoranthene (Idryl)					
Fluorene					
Glyphosate		700	CA/USEPA Primary MCL ^{(A) (C)}	25	1000 ^(E)
Hexachlorobenzene		1	CA/USEPA Primary MCL ^{(A) (C)}	0.5	0.03 ^(E)

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Table 2. Data Needs and Uses

Compound	Uses/Decisions	Applicable Regulatory Limit (µg/L)	Applicable ARAR (1)	California DHS DLR (µg/L) (2)	Additional Regulatory Limits (µg/L)
Hexachlorocyclopentadiene	Exceedances with respect to federal and state drinking water standards, and state action levels. Evaluate water treatment system design. Evaluate remedial action performance. ↓	50	CA/USEPA Primary MCL ^{(A) (C)}	1	50 ^(E)
Hexachloroethane					
Indeno(1,2,3-cd)pyrene					
Isophorone					
2-Methylnaphthalene					
2-Methylphenol					
4-Methylphenol					
3,4-Methylphenol					
2-Nitroaniline					
3-Nitroaniline					
4-Nitroaniline					
4-Nitrophenol					
Pentachlorophenol		1	CA/USEPA Primary MCL ^{(A) (C)}	0.2	0.4 ^(E)
Phenanthrene					
Phenol		4,200	CA DHS State Action Level (F)		
Pyrene					
Pyridine					
2,4,6-Trichlorophenol					
2,4,5-Trichlorophenol					
Emergent Compounds	Exceedances with respect to federal and state drinking water standards, and state action levels. Evaluate water treatment system design.				
1,4-Dioxane		3	CA DHS State Action Level (F)		15 (I)
N-Nitrosodimethylamine (NDMA)		0.01	CA DHS State Action Level (F)		0.02 (I)
1,2,3-Trichloropropane (1,2,3-TCP)		0.005	CA DHS State Action Level (F)		
Perchlorate		TBD		4	

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Table 2. Data Needs and Uses

Compound	Uses/Decisions	Applicable Regulatory Limit (µg/L)	Applicable ARAR (1)	California DHS DLR (µg/L) (2)	Additional Regulatory Limits (µg/L)
Treatment/Discharge Parameters					
Total Organic Parameters	Evaluate groundwater treatment alternatives.				
Total Organic Carbon	Evaluate treated				
Biological Oxygen Demand	groundwater discharge				
Chemical Oxygen Demand	alternatives.				

Notes:

- (1) ARARs from June 2003 California EPA Compilation of Water Quality Goals and Updates through September 2003.
- (2) California Department of Health Services required Detection Limit for Purposes of Reporting (DLR).
- (3) Calculated ARAR based on hardness = 120 mg/L as CaCO₃
- (A) California Department of Health Services Primary MCL for Drinking Water.
- (B) California Department of Health Services Secondary MCL for Drinking Water.
- (C) USEPA Primary MCL for Drinking Water.
- (D) USEPA Secondary MCL for Drinking Water.
- (E) California Office of Environmental Health Hazard Assessment Public Health Goal for Drinking Water.
- (F) California Department of Health Services State Action Level for Toxicity.
- (G) California Department of Health Services State Action Level for Taste and Odor.
- (H) Other Taste and Odor Thresholds.
- (I) California Proposition 65 Regulatory Level for Drinking Water.


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Table 2. Data Needs and Uses

Compound	Uses/Decisions	Applicable Regulatory Limit (µg/L)	Applicable ARAR (1)	California DHS DLR (µg/L) (2)	Additional Regulatory Limits (µg/L)
Emergent Compounds					
Chromium (VI)	Exceedances with respect	11(0.2) ⁴	California Toxics Rule for Aquatic Life Protection	0.5	0.4 ^(E)
Perchlorate	to federal and state drinking	4	CA DHS State Action Level (F)	0.5	7 ^(C) ; 10 ^(E)
	water standards, and state			0.5	70 ^(C)
	action levels.			0.5	100 ^(C)
	Evaluate water treatment			0.5	4 ^(E)
	system design.				
TAL Inorganics					
Aluminum	Exceedances with respect	50	USEPA Secondary MCL ^(D) 11	0.5	0.5 ^(E)
Antimony	to federal and state drinking	6	CA/USEPA Primary MCL ^(A) (C)		
Arsenic	water standards, and state	10	USEPA Primary MCL ^(C)		
Barium	action levels.	1,000	CA Primary MCL ^(A)	0.5	0.2 ^(E)
Beryllium	Evaluate groundwater	4	CA/USEPA Primary MCL ^(A) (C)	0.5	0.2 ^(E)
Cadmium	treatment alternatives and	5	CA/USEPA Primary MCL ^(A) (C)		
Calcium	treated groundwater				
Chromium (total)	discharge options.	50	CA Primary MCL ^(A)	0.5	700 ^(C) ; 300 ^(E) ; 29 ^(H)
Cobalt					
Copper		11 ²	California Toxics Rule for Aquatic Life Protection ^(H)		
Iron		300	USEPA Secondary MCL ^(D) 11	0.5	
Lead		3.1	California Toxics Rule for Aquatic Life Protection ^(H)		
Magnesium					
Manganese		50	CA/USEPA Secondary MCL ^(B) (D)	5	
Mercury		2	CA/USEPA Primary MCL ^(A) (C)		1300 ^(H)
Molybdenum					
Nickel		61	California Toxics Rule for Aquatic Life Protection ^(H)		
Potassium					
Selenium		5	California Toxics Rule for Aquatic Life Protection ^(H)		

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Table 2. Data Needs and Uses

Compound	Uses/Decisions	Applicable Regulatory Limit (µg/L)	Applicable ARAR (1)	California DHS DLR (µg/L) (2)	Additional Regulatory Limits (µg/L)
Silver	Exceedances with respect to federal and state drinking water standards, and state action levels. Evaluate groundwater treatment alternatives and treated groundwater discharge options.	4.7 ⁽²⁾	California Toxics Rule for Aquatic Life Protection	10	100 ^{(B) (D)}
Sodium					
Thalium		2	CA/USEPA Primary MCL ^{(A) (C)}	1	0.1 ^(E)
Vanadium		50	CA DHS State Action Level (F)	3 (preliminary)	
Zinc		140 ⁽²⁾	California Toxics Rule for Aquatic Life Protection	50	5000 ^{(B) (D)}
Cyanide		5.2	California Toxics Rule for Aquatic Life Protection	100	200 ^(C) , 150 ^(E)
Additional Inorganics					
Boron	Evaluate groundwater treatment alternatives and treated groundwater discharge options.	1,000	CA DHS State Action Level ^(F)		
Silicon					
Treatment/Discharge Parameters					
pH	Evaluate groundwater treatment alternatives and treated groundwater discharge options.	6.5 to 8.5	USEPA Secondary MCL ^(D)		
Alkalinity					
Ammonia		500	Other Taste and Odor ^(H)		
Bicarbonate					
Bromide	Exceedances with respect to federal and state drinking water standards, and state action levels.				
Chloride		250,000	CA/USEPA Secondary MCL ^{(B) (D)}		
Fluoride		1,000	CA PHG ^(E)	100	2000 ^{(A) (D)}
Nitrate (as N)		10,000	USEPA Primary MCL ^(C)		10000 ^(E)
Nitrite (as N)		1,000	CA/USEPA Primary MCL ^{(A) (C)}	400	1000 ^(E)
Phosphorus					
(orthophosphate, total phosphorus)					
Sulfate		250,000	CA Secondary MCL ^(B)	500	250,000 ^(D)

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Table 2. Data Needs and Uses

Compound	Uses/Decisions	Applicable Regulatory Limit (µg/L)	Applicable ARAR (1)	California DHS DLR (µg/L) (2)	Additional Regulatory Limits (µg/L)
Total dissolved solids (TDS)	Evaluate groundwater treatment alternatives and treated groundwater discharge options. Exceedances with respect to federal and state drinking water standards, and state action levels.	250,000	CA/USEPA Secondary MCL ^{(B) (D)}		

Notes:

(1) ARARs from June 2003 California EPA Compilation of Water Quality Goals and Updates through September 2003.

(2) Calculated ARAR based on hardness = 120 mg/L as CaCO₃

(3) California Department of Health Services required Detection Limit for Purposes of Reporting (DLR).

(4) 0.2 µg/L detection level is needed for comparability to other databases in the region per previous DHS limit.

(A) California Department of Health Services Primary MCL for Drinking Water.

(B) California Department of Health Services Secondary MCL for Drinking Water.

(C) USEPA Primary MCL for Drinking Water.

(D) USEPA Secondary MCL for Drinking Water.

(E) California Office of Environmental Health Hazard Assessment Public Health Goal for Drinking Water.

(F) California Department of Health Services State Action Level for Toxicity.

(G) California Proposition 65 Regulatory Level for Drinking Water

(H) California Toxics Rule for Freshwater Aquatic Life Protection - Continuous (4-day average) Concentration.

(I) California Toxics Rule for Freshwater Aquatic Life Protection - Maximum (1-hr average) Concentration

(J) Other Taste and Odor Thresholds

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Table 3. Measurement Performance Criteria

Parameter	Method	Target Detection Limit	Analytical Accuracy (%Recovery)	Analytical Precision (Relative % Deviation)	Overall Completeness (%)
Volatile Organic Compounds					
TCL Volatile Organic Compounds (VOCs) plus MTBE ^a	EPA 8260B	(c)	70-130/CLP	±30/CLP	90
TCL ^a Semivolatile Organic Compounds (SVOCs)	EPA 8270C	(c)	CLP		
Emergent Compounds					
1,4-Dioxane	EPA 8720 ^b	1 µg/L	40-130	±30	90
NDMA	Mod. EPA 1625 ^b	0.02 µg/L	50-125	±30	90
Perchlorate	EPA 314 ^{b,d}	5 µg/L	50-150	±50	90
Hexavalent Chromium	EPA 218.6 ^{b,d}	0.2 µg/L	70-140	±30	90
1,2,3 TCP	(i)	0.005 µg/L	(i)	(i)	90
Groundwater Treatment and Discharge Parameters					
TAL ^a Metals (field filtered)	EPA 6010/7000				
Boron	EPA 200.8 ^{d,b}	(g)	70-130	±30	90
Silicon	EPA 245.1/CLP				
Cyanide	EPA 335.4 ^{d,b}	10 mg/L	75-125	±25	90
Bromide	EPA 300.0 ^{d,b}	1.0 mg/L	75-125	±25	90
Chloride	EPA 300.0 ^{d,b}	1.0 mg/L	75-125	±25	90
Fluoride	EPA 300.0 ^{d,b}	0.1 mg/L	75-125	±25	90
Nitrate-N	EPA 300.0 ^{d,b}	0.1 mg/L	75-125	±25	90
Nitrite-N	EPA 300.0 ^{d,b}	0.1 mg/L	75-125	±25	90
Orthophosphate-P	EPA 300.0 ^{d,b}	1.0 mg/L	75-125	±25	90
Total Sulfate	EPA 300.0 ^{d,b}	1.0 mg/L	75-125	±25	90
Total Kjeldahl Nitrogen (TKN)	EPA 351.2 ^{d,b}	1.0 mg/L	75-125	±25	90
Ammonia	EPA 350.2 ^{d,b}	0.3 mg/L	75-125	±25	90
Total Phosphorus	EPA 365.4 ^{d,b}	0.3 mg/L	75-125	±25	90
Total Dissolved Solids (TDS)	EPA 160.1 ^{d,b}	20 mg/L	75-125	±25	90
Alkalinity	SM 2320B ^{b,e}	20 mg/L	75-125	±25	90
Total Organic Carbon	EPA 415.1 ^d	2.0 mg/L	75-125	±30	90

Table 3. Measurement Performance Criteria

Parameter	Method	Target Detection Limit	Analytical Accuracy (%Recovery)	Analytical Precision (Relative % Deviation)	Overall Completeness (%)
BOD	SM 5210B ^e	3mg/L	75-125	±25	90
COD	SM 5220D ^e	5.0 mg/L	75-125	±30	90
Field Analysis for Volatile Organics	(i)	(j)	(j)	(j)	90

^a Target Compound List (TCL) and Target Analyte List (TAL) as shown in Table 2

MTBE: methyl tert butyl ether.

^b Volatile organics, semivolatile organics, metals and cyanide may be analyzed by the EPA Contract Laboratory Program (CLP) Statement of Work or the equivalent EPA Regional Laboratory Standard Operating Procedures, depending on availability.

^c For volatile organics, detection limits will be at 1 part per billion (ppb) for all except 0.5 ppb for vinyl chloride, carbon tetrachloride, 1,2 dichloroethane, cis and trans-1,3-dichloropropene, and 2 ppb for 1,2-dibromo-3-chloropropene.

^d U.S. Environmental protection Agency, 1979. *Methods for Chemical Analysis of Water and Wastes*, EPA-600/4-79-020, revised March 1983; U.S. Environmental Protection Agency, *Test Methods for Evaluating Solid Waste*, SW846.

^e *Standard Methods for the Examination of Water and Wastewater*, 17th Edition (1989).

^f State of California Department of Health Services (DHS) method Determination of Perchlorate by Ion Chromatography, as detailed in EPA Region IX SOP in Appendix B.

^g Slica by EPA 200.7 and will have a detection level <0.1 part per million (ppm).

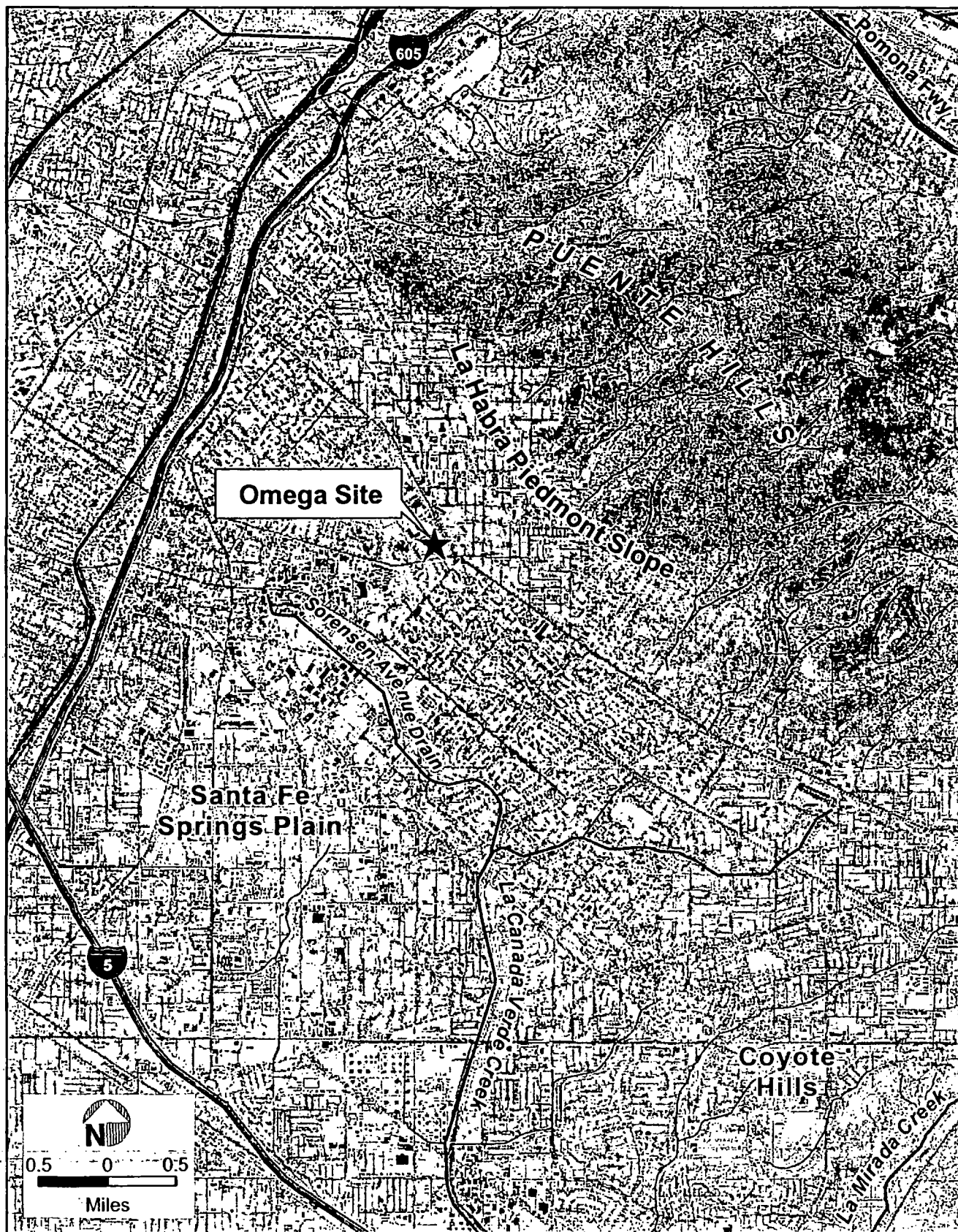
^h Target detection level is reporting level, see text for explanation.

ⁱ The method and QA/QC will follow California State guidance to achieve the needed low regulatory limit. Laboratory-specific standard operating procedures will be defined prior to start of work, and subsequent to selection of laboratory.

^j Volatile organics to be analyzed in the field will be the same list as the offsite laboratory analyses (a), target detection levels will also be equivalent to the offsite laboratory analyses. Method will be based on 8260/GC/MS. Method and field laboratory-specific standard operating procedures will be defined prior to start of work.

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Figures



SOURCE: CHRM HILL, INC. FIGURE 1-1 SITE LOCATION MAP

Area Manager	K. THOMAS
Project Director	J. FRIEDMAN
Task Manager	R. HALPERN
Technical Review	R. HALPERN



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SITE LOCATION MAP

OMEGA CHEMICAL SUPERFUND SITE
WHITTIER, CALIFORNIA


Project Number	CA646.01.01
Drawing Date	9/7/04
Figure	1-1

System	Series	Formation		Aquifer and Aquiclude	Thickness (feet)
QUATERNARY	RECENT	ALLUVIUM		BELLFLOWER AQUICLUDE	10-40
				GASPAR	0-30
	UPPER PLEISTOCENE	LAKEWOOD FORMATION		BELLFLOWER AQUICLUDE	10-40
				ARTESIA	0-40
				GAGE	0-30
	LOWER PLEISTOCENE	SAN PEDRO FORMATION		UNCONFORMITY	
				HOLLYDALE	0-40
				JEFFERSON	20-40
				LYNWOOD	50-100
				SILVERADO	100-300
TERTIARY	UPPER PLEISTOCENE	PICO FORMATION		SUNNYSIDE	200-300
				UNCONFORMITY	
				UNDIFFERENTIATED	

SOURCE: CH2M HILL, INC. FIGURE 2-1 GENERALIZED STATIGRAPHIC COLUMN

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 Layout : Layout1

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Project Director J. FRIEDMAN			Drawing Date 9/7/04
Task Manager R. HALPERN			Figure 2-1
Technical Review R. HALPERN			

Acad Version : R16.1s (LMS Tech) Date/Time : Wed, 08 Sep 2004 - 1:11pm User Name : equinones Path Name : C:\DRAWINGS\PROJECT\OMEGA CHEMICAL\PCCE Concentrations in GW.dwg Plot Job: Layout?



Legend

Wells

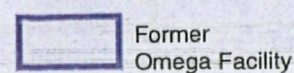
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- Monitoring Well

MW08A = Station Name
580 = Concentration Value

Hydropunch

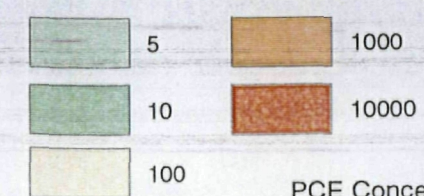
- Proposed Extraction Well
- Proposed Monitoring Well
- CPT Boring
- Auger Boring

PP062 = Station Name
250 = Concentration Value



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Omega Facility

PCE Concentration (ug/L)



PCE Concentrations Contours from Weston, 2003

0 500 1,000
Feet



SOURCE: CH2M HILL, INC. FIGURE 2-2 PCE CONCENTRATIONS IN GROUNDWATER

PCE CONCENTRATIONS IN GROUNDWATER

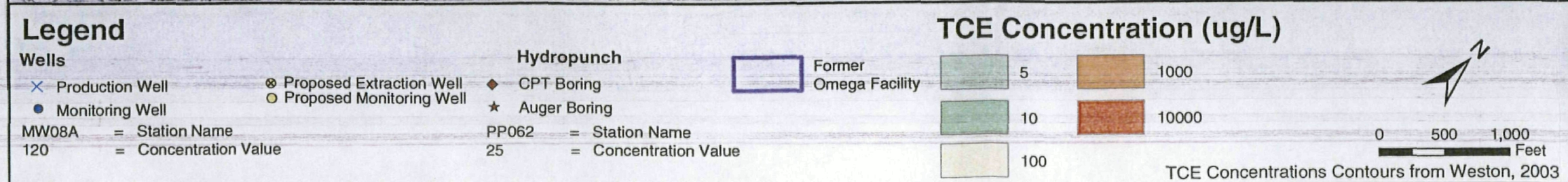
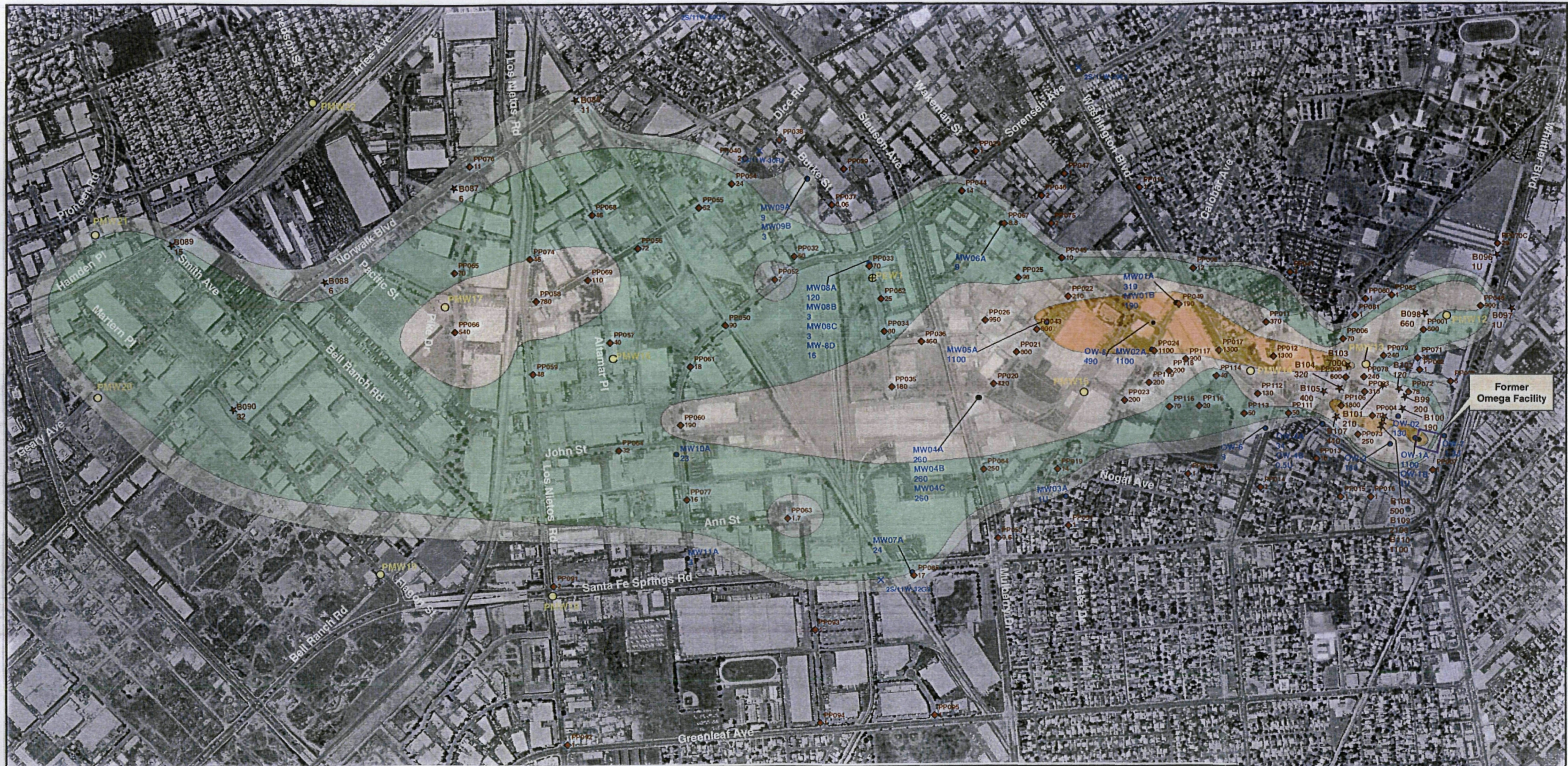
OMEGA CHEMICAL SUPERFUND SITE
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Drawing Date
9/7/04
Figure



SOURCE: CH2M HILL, INC. FIGURE 2-3 TCE CONCENTRATIONS IN GROUNDWATER

TCE CONCENTRATIONS IN GROUNDWATER

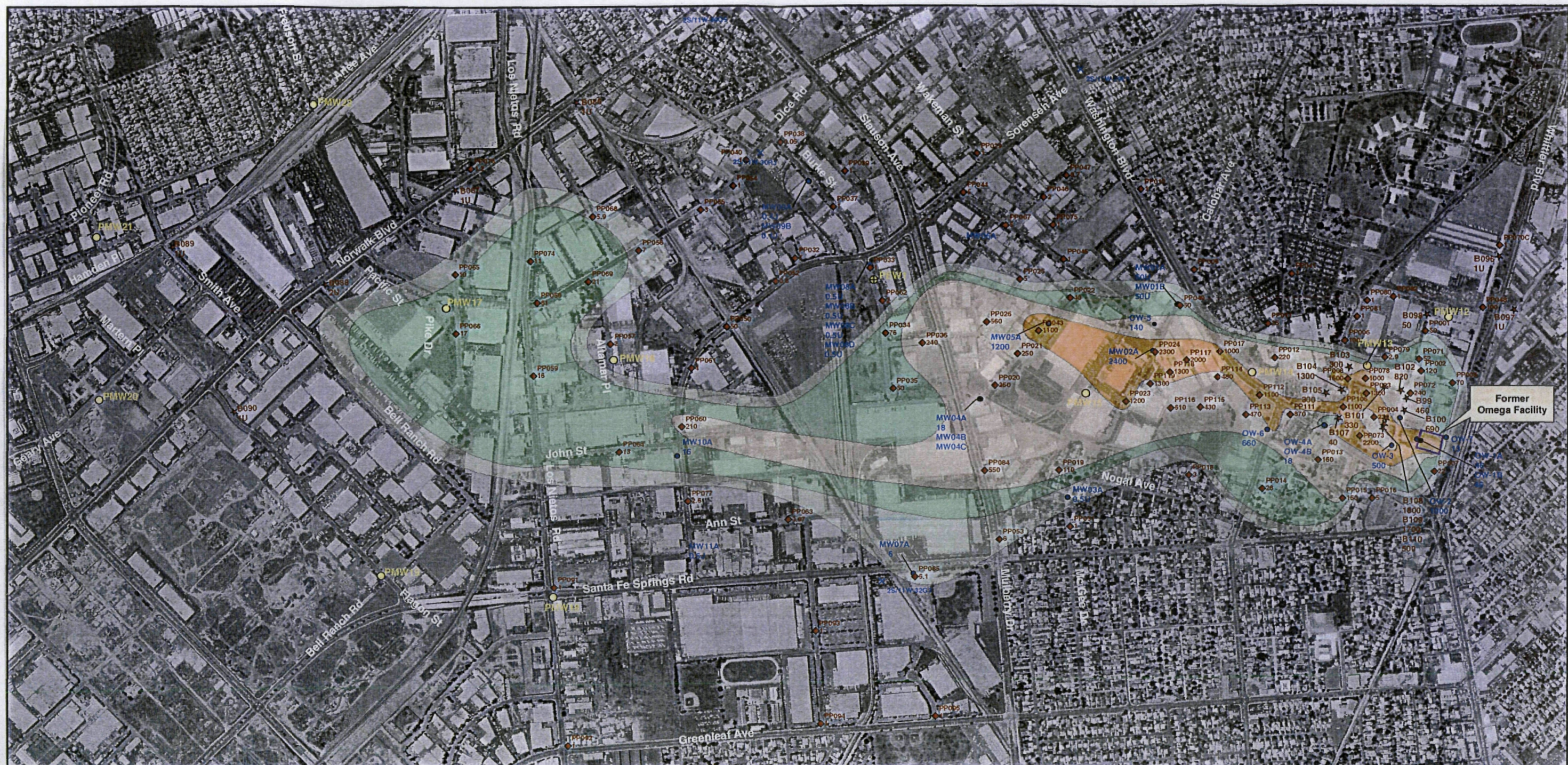
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Figure	2-3

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Current Plot Style : BColor



Legend

Wells

- Production Well
- Monitoring Well
- Proposed Extraction Well
- Proposed Monitoring Well

Hydropunch

- CPT Boring
- Auger Boring

PP062 = Station Name
0.5 = Concentration Value

Former Omega Facility

FREON 113 Concentration (ug/L)

5	1000
10	10000
100	

0 500 1,000 Feet

FREON 113 Concentrations Contours from Weston, 2003

SOURCE: CH2M HILL, INC. FIGURE 2-5 FREON 113 CONCENTRATIONS IN GROUNDWATER

FREON 113 CONCENTRATIONS IN GROUNDWATER

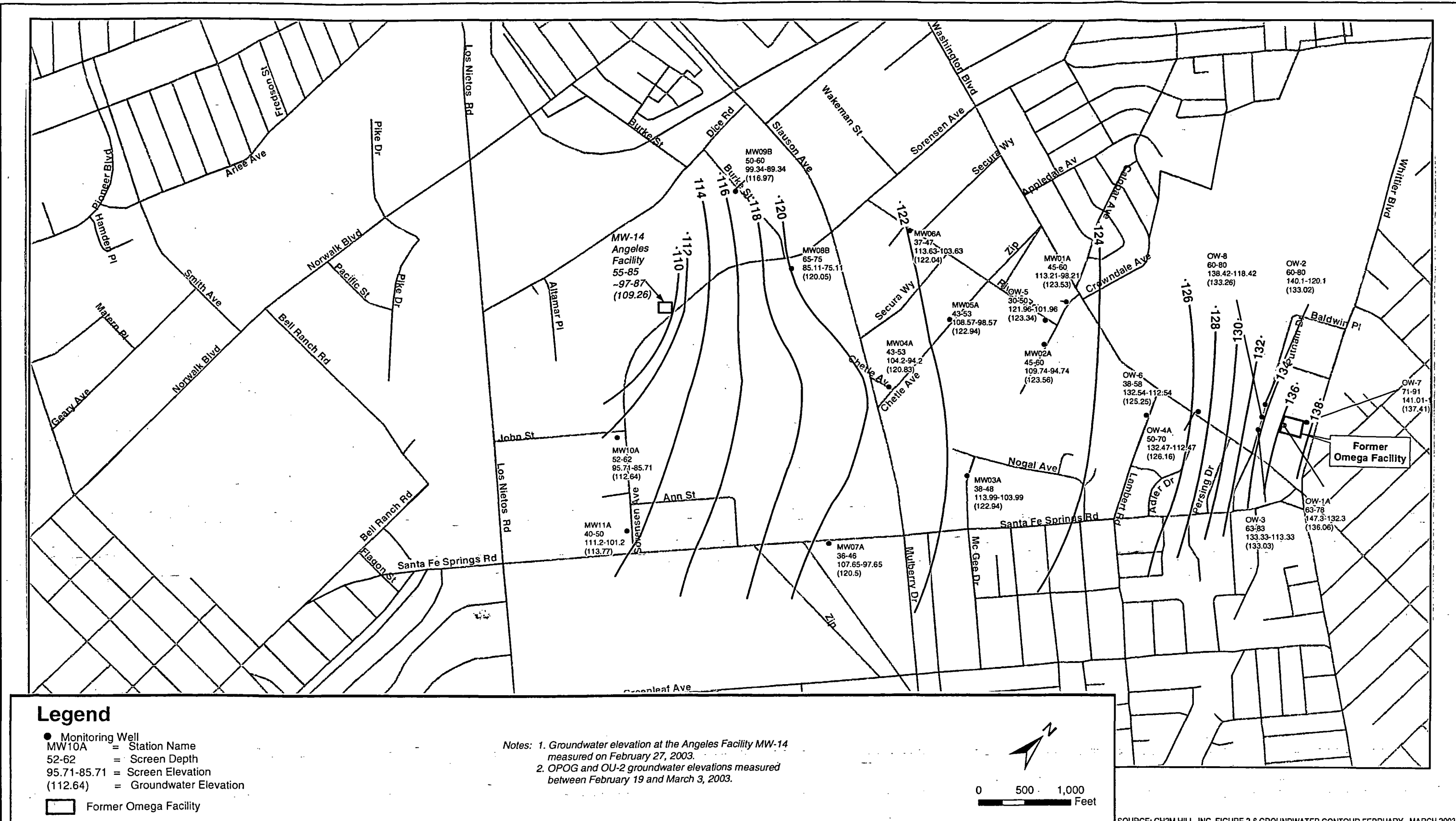
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Drawing Date	9/7/04
Figure	2-5

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Legend

- Monitoring Well
- MW10A = Station Name
- 52-62 = Screen Depth
- 95.71-85.71 = Screen Elevation
- (112.64) = Groundwater Elevation
- Former Omega Facility

Notes: 1. Groundwater elevation at the Angeles Facility MW-14 measured on February 27, 2003.
2. OPOG and OU-2 groundwater elevations measured between February 19 and March 3, 2003.



SOURCE: CH2M HILL, INC. FIGURE 2-6 GROUNDWATER CONTOUR FEBRUARY - MARCH 2003

GROUNDWATER CONTOURS FEBRUARY - MARCH 2003

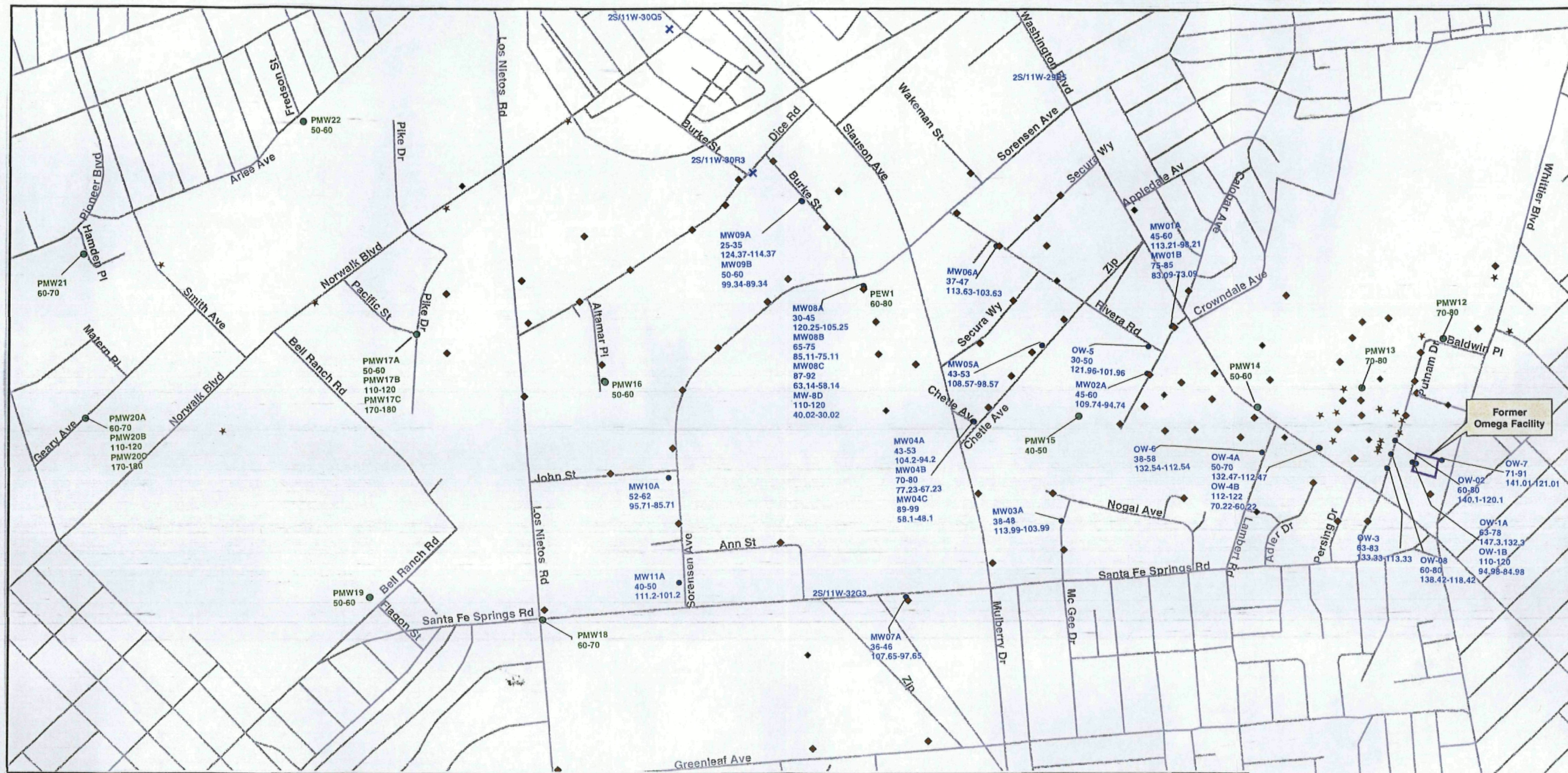
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Figure
2-6

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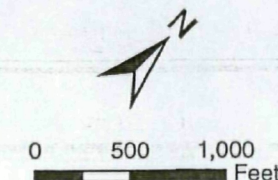
Wells

- ✕ Production Well
 - Monitoring Well
 - ✕ Proposed Extraction Well
 - Proposed Monitoring Well
- MW10A
52-62
95.71-85.71 = Station Name
= Screen Depth
= Screen Elevation

Hydropunch

- ◆ CPT Boring
- ★ Auger Boring

Former Omega Facility



SOURCE: CH2M HILL, INC. FIGURE 3-1 PROPOSED WELL LOCATIONS

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Task Manager R. HALPERN	
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PROPOSED WELL LOCATIONS

OMEGA CHEMICAL SUPERFUND SITE
WHITTIER, CALIFORNIA

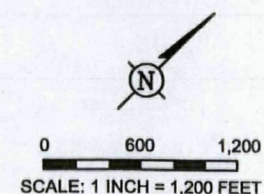
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Drawing Date 9/7/04
Figure 3-1



AERIAL PHOTO FROM AIRPHOTO, 2004

LEGEND

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- MW# EPA-PROPOSED GROUNDWATER MONITORING WELL LOCATION
- PMW# ALTERNATE PROPOSED GROUNDWATER MONITORING WELL LOCATION
- PRODUCTION WELL
- # WELL LOCATION AND PLUME UNITS FROM EPA 2004
- EPA ESTIMATED LATERAL EXTENT OF OU-2 BASED ON 2003 DATA
- - - ARCADIS ESTIMATED LATERAL EXTENT OF OU-2 IN 2004, ASSUMING 750 FEET MIGRATION



PROPOSED AND ALTERNATE WELL LOCATIONS

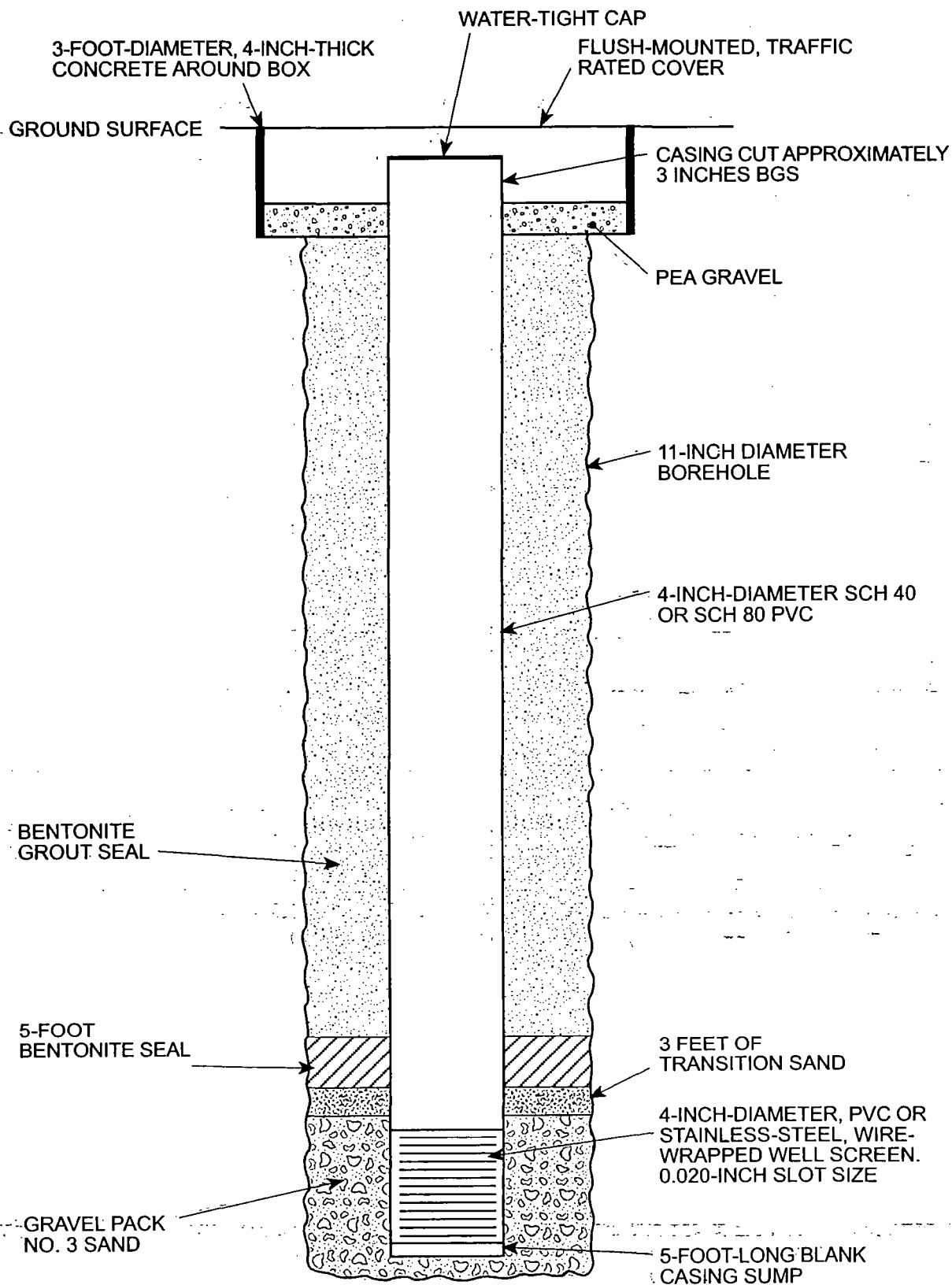
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R. HALPERN
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R. HALPERN

Project Number
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Drawing Date
11/9/04
Figure
3-2




NOT TO SCALE

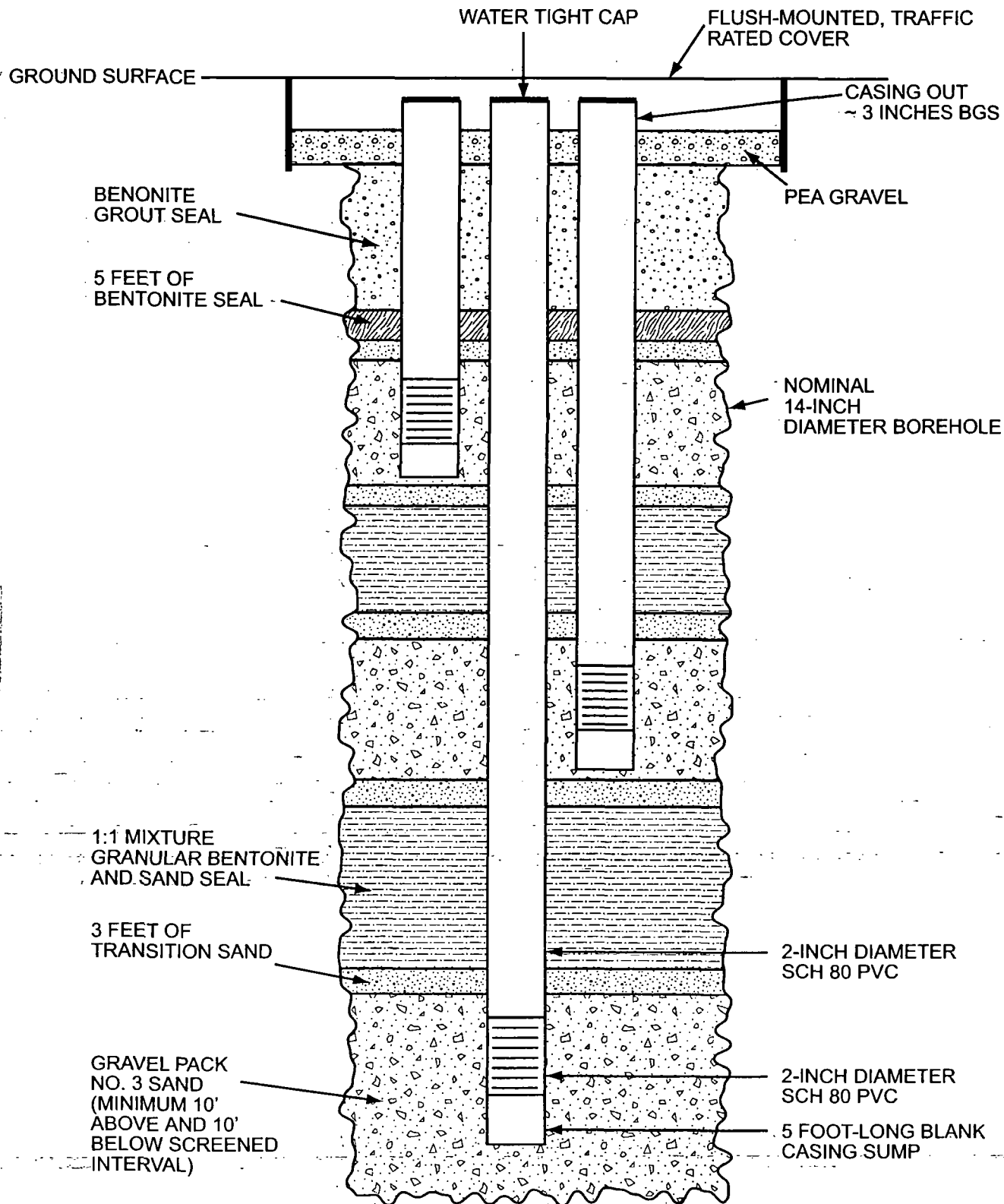
SOURCE: CHRM HILL, INC. FIGURE 5-1 TYPICAL SINGLE CASING WELL COMPLETION DIAGRAM

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Layout Tab: Layout1

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	Project Director J. FRIEDMAN			Drawing Date 9/7/04
	Task Manager R. HALPERN			Figure 5-1
	Technical Review R. HALPERN			



SOURCE: CHRM HILL, INC. FIGURE 5-2 TYPICAL MULTIPLE CASING WELL COMPLETION DIAGRAM

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Acad Version: R16.1a (LMS Tech)
User Name: equinorea

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TYPICAL MULTIPLE CASING WELL COMPLETION DIAGRAM

OMEGA CHEMICAL SUPERFUND SITE
WHITTIER, CALIFORNIA

Project Number

CA646.01.01

Drawing Date

9/7/04

Figure

5-2

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Appendix A

Health and Safety Plan

OMEGA SMALL VOLUME GROUP

HEALTH AND SAFETY PLAN

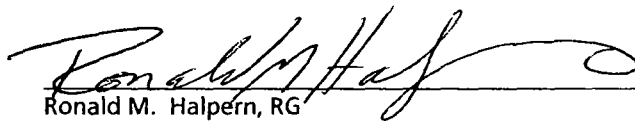
OMEGA CHEMICAL OPERABLE
UNIT 2, WHITTIER, CA

EPA Site ID#09BC
Docket No. 9-2004-004



Infrastructure, buildings, environment, communications

ARCADIS



Ronald M. Halpern, RG
Project Scientist



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Program Manager

Health and Safety Plan

Omega Chemical Operable
Unit 2, Whittier, CA

Prepared for:
Omega Small Volume Group (OSVOG)

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1. Introduction

This Health and Safety Plan (HASP) has been developed to address the potential hazards that our workers may face while performing the various tasks to complete the planned site assessment activities. The HASP establishes procedures to minimize workers' exposures through the use of personal protective equipment (PPE) and safe work practices. This HASP has been developed to meet the requirements of the Occupational Safety and Health Administration (OSHA) regulation, Title 29, Code of Federal Regulations, Part 1910.120 (20 CFR 1910.120), "Hazardous Waste Operations and Emergency Response." The HASP is intended for the protection of our workers, however, subcontractors, clients, visitors, or any other individuals are welcome to review and follow the procedures it contains.

2. Responsibilities

The on-site geologist/engineer/technician overseeing field work will be designated as the Site Safety Officer (SSO). The SSO will be an employee of ARCADIS. The SSO will be responsible for implementing the procedures and safe work practices established in this HASP. In the event that the SSO must leave the site while the work is in progress, an alternate SSO will be designated to ensure that the HASP will continue to be followed. The alternate SSO must also be an employee of ARCADIS.

The SSO will report all health and safety matters to the Project Manager, Mr. John Johnsen, who has responsibility for overseeing the planned activities and liaisons/coordinators with OSVOG. Mr. Kevin Thomas, Health and Safety Officer for ARCADIS in Fullerton, will assist as needed. In the event that Mr. Johnsen is not available, Mr. Thomas will provide direction regarding health and safety issues associated with this project.

3. Site Description

This HASP will be used to address health and safety concerns associated with field activities at the Omega Chemical Operable Unit-2. The Omega Chemical facility (also known as Operable Unit 1 [OU-1]) is located at 12504 and 12512 East Whittier Boulevard in Whittier, California (see Figure 1). The Environmental Protection Agency (EPA) had termed the name "Operable Unit 2" (or OU-2) to describe an area that extends approximately 2 miles southwest of OU-1 below which groundwater has been impacted by various halogenated solvents. EPA has directed a group of principle

responsible parties (PRPs), known as the Omega Small Volume Group (OSVOG) to install 11 groundwater monitoring wells and one extraction well within the OU-2.

4. Planned Field Activities

The following is a brief description of the planned field activities for the on-site and off-site work:

- Mark boring locations;
- Clear boring locations of underground utilities;
- Advance CPT borings and collect depth-specific water samples;
- Advance and install groundwater monitoring wells in off-site streets and private party locations;
- Develop and sample groundwater monitoring wells;
- Investigative Derived Waste (IDW) Management

5. Project-Specific Hazards

5.1 Drilling

Working within the vicinity of operating drill rigs poses numerous safety considerations. Most hazards, as with other mechanized devices, are physical in nature. For drill rigs, these physical hazards include being struck by a falling or flying object, direct contact with a rotating or moving object (such as the auger), lifting of heavy equipment, and pinching. Frequently injured body parts include eyes, back, fingers, hands, feet and knees.

Care shall be taken by all personnel to exercise caution when working with all mechanized equipment, primarily drill rigs, to prevent clothing from being caught in moving parts, placing body parts in close vicinity to pinch points on equipment, or using the equipment on slopes or unstable surfaces in excess of manufacturer's recommendations. Site personnel, visitors, or other persons who are not performing necessary work shall remain at a distance of at least 15 ft from the drill rig, and all workers within 15 ft of the equipment are required to wear, at a minimum, hard hats, safety glasses with side protection, steel-toed boots, gloves, and hearing protection. All workers within 15 feet of the equipment will not wear loose-fitting clothing or other

items, such as rings or watches, which could get caught in moving parts. Long hair should be restrained.

5.2 Vehicular Traffic

Hazards associated with vehicular traffic are described in Section 6.1.5 below.

6. Hazard Evaluation and Control

The potential physical, chemical, and biological hazards associated with the planned field activities for this site have been evaluated using existing site information. The hazard evaluation included such considerations as tasks to be performed, site history, and past sampling results. The hazards anticipated during typical site assessment operations are summarized in the Table 1 and described in detail in the following subsections.

6.1 Physical Hazards

The physical hazards associated with the planned field activities include the following potentialities:

6.1.1 Slip, Trip and Fall

Slipping, tripping and falling hazards include slipping on wet or uneven surfaces; tripping over debris, equipment, vegetation, or objects; and falling into trenches or excavations.

It is unlikely that workers will be exposed to trenches or excavations during the course of field activities; however, it is likely that drilling activities at a particular location may occur over more than one day, making falling into a borehole a possibility.

Protective measures against slip, trip and fall scenarios are primarily physical:

- Site work should be performed during daylight hours whenever possible. Should work need to be performed after sunset, sufficient lighting must be provided to illuminate the entire work area. Illumination should be of such intensity to allow reading a newspaper without difficulty.

- Good housekeeping in the work area must be maintained at all times. Organize materials and equipment in accessible locations while maintaining a clear work area or walking path.
- As work progresses, scrap and unessential materials must be neatly stored or removed from the work area. Containers should be provided for collecting trash and other debris and should be removed at regular intervals.
- All spills shall be quickly cleaned up. Oil and grease shall be cleaned from walking and work surfaces.
- When walking in mixed (or uneven) terrain, staff shall remain on a paved or otherwise designated path. Caution shall be used when walking on grassy or gravelly terrain. When walking on unpaved terrain, caution shall be used to identify potholes and/or burrows made in the soil by animals. Where practical, these holes shall be clearly marked.
- Caution shall be exercised when working near slopes. If possible, refrain from walking on the slopes. If not possible, exercise sufficient caution and common sense to minimize the potential for slipping and falling – use guardrails, ladders, ropes, or other appropriate devices.
- Use common sense.

6.1.2 Flying Debris or Objects

Flying debris or objects are a common hazard in the work area. Flying debris can be thrown by passers-by; shot out from under a tire; or flying shavings, particles, or shards from using various tools.

Protective measures against flying debris are primarily physical: Safety glasses with side protection shall be worn at all times while in the work area.

6.1.3 Noise

Working around heavy equipment and/or loud noises for prolonged periods of time, or exposure to a short, very loud noise (such as an explosion) can cause hearing damage. Noise levels shall be either monitored within the work area, using a sound-level meter, during activities involving heavy equipment or assumed hazardous. Hearing protection

will be required in all work areas where noise levels are above 85 decibels (dBA). Hearing protection shall be required for personnel working in the area of the operating equipment.

Protective measures against exposure to loud noise are primarily physical: Hearing protection must be worn at all times heavy equipment is in operation.

6.1.4 Heavy Loads – Back Injury

Heavy Loads. Hazards associated with this category include back injury due to an attempt to lift heavy loads.

Protective measures against back injury resulting from lifting heavy loads are primarily physical:

- Get help with lifting loads greater than 50 pounds. If help is not available, try using another method of transporting the heavy load (e.g., using a dolly or cart).
- When lifting loads (of any weight), bend down, keeping your back straight. Grab hold of the object and lift with your legs, keeping your back straight.

6.1.5 Vehicular Traffic

The following precautions must be taken when working around traffic, and in or near an area where a contractor has established traffic controls.

- If work will be performed in a traveled way, an approved Traffic Control Plan will be prepared and implemented in accordance with permit requirements. The Traffic Control Plan should be prepared to specifications by the permitting agency, or to one of the following documents, as appropriate: *The Work Area Traffic Control Handbook* (latest edition) by BNi Building News; *Manual of Traffic Controls for Construction and Maintenance Work Zones* (latest edition), published by the State of California Department of Transportation (DOT); or, the *Manual on Uniform Traffic Control Devices for Streets and Highways – Part 6: Temporary Traffic Control* (latest edition), published by the United States DOT – Federal Highway Administration.

- When arriving at the work site, exercise caution when exiting the traveled way or parking along the street. Avoid sudden stops. Use automobile signaling device to warn drivers behind of pending lane changes.
- Park in a manner that will allow for safe exit from vehicle. Where practical, park vehicle so that it will serve as a barrier between staff and oncoming traffic. When parking in this manner, make sure there is a buffer zone between staff and the parked vehicle to prevent injury in the event of impact to the vehicle by oncoming traffic.
- All staff working adjacent to a traveled way, or within the work area, must wear reflective/high-visibility safety vests.
- Eye protection and a hard hat should be worn at all times to protect from flying debris.
- Remain aware of factors that influence traffic-related hazards and required controls: sun glare, rain, wind, flash flooding, limited sight distance, hills, curves, guardrails, width of shoulder, etc.
- Work as far from the traveled way as possible to avoid creating confusion for drivers, and allowing the maximum safety buffer as possible.
- When working alone, always face traffic when performing the assigned task. When workers must face away from traffic, a buddy system should be used, where one worker looks toward oncoming traffic with the other worker performs the assigned tasks.
- When working around company or contractor vehicles (as when performing a soil gas survey), the drivers of said vehicles must walk around their vehicle, prior to driving off, and visually determine that workers are not in danger of being run over.

6.1.6 Mechanical Hazards Associated With Equipment

Hazards of this category include being struck by equipment; clothing being caught by equipment resulting in bodily damage; exposure to noise from heavy equipment or other noise-emitting tools; exposure to high voltage electricity; and hazards associated with working in traffic areas.

Heavy equipment likely to be used during the proposed scope of work includes drill rigs, fork lifts, trucks, and a pressure washer.

Protective measures against mechanical hazard scenarios are primarily physical:

- Long hair shall be collected so it is not loose.
- Excessively loose fitting clothing will not be worn at the work site.
- A helmet, eye protection, ear protection, work gloves, and steel-toed boots will be worn while in vicinity of equipment.
- Heavy equipment operators must have the required certification or evidence of training that qualifies them to operate the machinery. Equipment delivered to the site should be inspected upon arrival and daily thereafter. Equipment operators should verify the equipment working areas are free of non-operating personnel.

6.1.7 Electrical Hazards Associated With Equipment

With the exception of a portable low-flow pump (for groundwater sampling), ARCADIS personnel are not likely to be operating any electrical equipment at the Site. The portable pump utilizes a gasoline-powered air compressor connected to the pump apparatus. All moving parts in the air compressor are covered. The following sections pertain to the health and safety guidelines regarding this equipment.

6.1.8 Hand and Power Tools

Hand and power tools present serious hazards, especially to fingers and hands, and can cause eye injuries resulting from flying debris. All hand and power tools shall be inspected prior to use to ensure that all are in good condition with properly working parts, and are appropriate for the task. All power tools shall also be inspected for proper wiring and grounding, and to ensure that all of the safety guards and switches provided by the manufacturer are present and in good working condition. If any hand tool does not meet the criteria specified in this section, the tool will be tagged and repaired by a properly trained individual, or replaced.

Gasoline powered equipment such as an air compressor will be used only in well-ventilated areas.

6.1.9 Fuel Handling

The refueling of gasoline-powered equipment shall not be performed while the equipment is in operation. The engine shall be allowed to cool prior to refueling.

6.2 Environmental Hazards

From personnel workload and the weather conditions, there is a moderate to high risk of weather related stress depending on the season. This includes heat stress/exhaustion, sunstroke, cold stress and adverse weather conditions. Weather conditions change day to day and will be discussed during the daily "tail-gate" health and safety meetings. Conditions that affect site conditions can include high winds, heavy rain, flooding, lightning, dense fog, and sun. During the field activities, the SSO will determine the daily monitoring requirements and/or whether work will proceed based on the weather conditions. ARCADIS will be responsible for these activities. The following sections describe the symptoms of heat and cold stress, and the administrative and engineering controls for this hazard.

6.2.1 Heat Stresses

Field activities are likely to be performed during the first quarter of 2005, during the winter months. The potential for heat stress is unlikely, but is covered here for completeness. Heat stress is a significant hazard during the warm weather months, particularly if levels of health and safety protection are upgraded from level D to Level C or B. Symptoms of heat stress shall be monitored for all levels of health and safety protection at temperatures above 70 degrees Fahrenheit. Heat stress involves three general categories: heat cramps, heat exhaustion, and heat stroke.

- Heat cramps usually occur first and generally include cramps in the abdomen and legs.
- Heat exhaustion is more serious exhibiting symptoms such as: cool, moist, pale, or flushed skin, headache, nausea, dizziness, weakness, and exhaustion.
- Heat stroke is the most serious form of heat stress, and workers suffering from this condition should get immediate medical attention. The signals of heat stroke include red-hot dry skin, changes in consciousness, rapid weak pulse, and rapid shallow breathing.

Heat stress is caused by a number of interacting factors, including environmental conditions, personal protective equipment, workload, and the individual characteristics of the worker. Each individual has different susceptibilities to heat stress due to many factors. These factors may include age, physical fitness, degree of acclimatization, and the specific task being performed. Symptoms of heat stress are divided into five general categories as follows:

- Behavioral Disorders: A worker suffering from heat-induced fatigue demonstrates symptoms such as the inability to concentrate, impaired performance, and loss of coordination.
- Skin Eruptions: Skin eruptions include profuse, tiny, raised red vesicles (blister-like, aka a heat rash) on affected areas, prickling sensation during heat exposure, and prickly heat. During heat stress, extensive areas of the skin that do not sweat upon heat exposure, will present a goose-flesh appearance that subsides with cool environments.
- Heat Exhaustion: Heat exhaustion is a condition that results from extensive water and/or salt depletion. Symptoms include fatigue, nausea, headaches, giddiness, clammy skin, pale complexion, and fainting. Heat cramps, which are painful muscle spasms (arms, legs, or abdominal), are also a symptom of heat exhaustion and can occur during or after work hours.
- Heat Syncope: Symptoms associated with this stage of heat stress include fainting and becoming unable to move.
- Heat Stroke: Symptoms usually associated with heat stroke are hot, dry skin, which is usually red, mottled, or blue. Additional symptoms include confusion, loss of consciousness, and convulsions. Individual has stopped sweating and may be experiencing chills.

To minimize worker's exposures to heat stress, it is important for field personnel to recognize the early signs and symptoms of heat stress so that preventive measures can be taken. Preventive measures include work schedule adjustment, rotating personnel, and selection of personal protective equipment.

- Adjustment of Work Schedules: In environments of extreme heat and humidity, work schedules should be modified. Heavy work should be conducted during the cooler hours of the early morning or early evening when the ambient temperature

is usually lower. During the hotter hours, usually associated with mid-day, light work tasks should be performed whenever possible. Subcontractors should be informed of the potential for adjusted work schedules.

- Rotation of Personnel: By alternating job functions, a single worker may not be overstressed or overexerted as a result of performing heavy tasks throughout the day.
- Increase in Rest Periods: In extreme environmental conditions, the number of rest periods should be increased. Shaded areas or air-conditioned facilities (trailer, cars, and buildings) should also be provided for these rest periods so that workers can adequately recover.

Body fluids should also be maintained at normal levels. A good guideline to follow is that fluid intake should equal every ounce of bodily fluid lost in sweat. Water is recommended as the fluid of choice. (No salt should be administered.) Field showers or hose-down areas should be provided to reduce body temperature in the event of a heat related injury.

Early detection and safe work habits are the best measures for preventing heat stress hazards. Site workers exhibiting any of the signs of heat stress above should take preventive measures including getting out of the heat, loosen any tight clothing, applying cool wet cloths, and for conscious victims, consumption of approximately 4 ounces of water every 15 minutes. If the victim refuses water, vomits, or starts to lose consciousness, immediate medical attention should be sought. It is extremely important to drink plenty of fluids during hot weather, even when not thirsty, and to take rest breaks in order for the body to cool down.

Solar radiation is another hazard, and protection against sunburn and the long-term risks of skin cancer are necessary. Site workers should use sunscreen or cover the exposed parts of their bodies to protect against harmful ultraviolet rays. It should be remembered that covering the body as protection against ultraviolet rays might increase the likelihood of heat stress hazards. Keeping alert of warning signs and taking prompt preventive measures is critical to preventing hazards associated with the sun and heat.

6.2.2 Cold Stresses

If work is conducted during the winter, hypothermia may be a health hazard. Hypothermia occurs when the entire body cools because its ability to keep warm fails.

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The victim will die if not given care. People susceptible to hypothermia are those of ill health, drunk, or suffer from any medical condition that impairs circulation (diabetes or cardiovascular disease). ANYONE REMAINING IN COLD WATER OR WET CLOTHING FOR A LONG TIME MAY ALSO EASILY DEVELOP HYPOTHERMIA.

Symptoms: shivering, numbness, glassy stare, apathy, and loss of consciousness.

Administrative Methods to Protect Against Cold Stress:

- Provide/require rain gear including rubber steel-toed boots.
- Provide overhead shelter i.e. umbrella or tent.
- Require workers to take rest every hour, drink hot liquids.
- Make sure everyone has a dry set of clothes and towel to dry off.

Treatment:

- Remove any wet clothing and dry the victim.
- Warm the body gradually by wrapping the victim in blankets or putting on dry clothing and moving the victim to a warm place.
- Apply heat pads or other heat sources to the body if available.
- Keep a barrier such as a blanket, between the heat source and the victim to avoid burning them.
- If the victim is alert, give warm liquids to drink.
- DO NOT WARM THE VICTIM TOO QUICKLY, such as by immersing the victim in warm water as this can cause dangerous heart problems.
- In case of severe hypothermia where the victim is unconscious, make sure victim is breathing and seek professional medical attention as soon as possible. Provide rescue breathing if necessary until help arrives.

6.3 Chemical Hazards

Chlorinated VOCs have been detected in groundwater samples collected from the site. Given the planned site activities and the physical properties of the chemicals of concern, the potential exists for chemical exposure. The potential chemical exposure pathways are inhalation of volatilized chemicals of concern, accidental ingestion of impacted media, dermal contact with impacted media, and absorption through the eyes.

Table 2, "Exposure Limits for Constituents of Concern," in the Tables section at the end of this document, lists exposure limits for the constituents of concern at the Site in terms of the Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PELs) as a Time Weighted Average (TWA), Short Term Exposure Limit (STEL), and Ceiling Limit; as well as the National Institute of Occupational Safety and Health (NIOSH) Immediately Dangerous to Life and Health (IDLH) limit.

The chemical hazards associated with this site are based on the analytical data generated from previous sampling activities. The analytical data indicated that contaminants of concern (COCs) in the OU-2 include tetrachloroethene (PCE), trichloroethene (TCE), Freon 11, Freon 113, 1,2-dichloroethylene (1,2-DCE), and 1,1,1 trichloroethane (1,1,1-TCA). Based upon this information, the following exposure pathways have been identified in order to minimize each site worker's potential exposure to COCs (Table 2).

- Inhalation of vapors.
- Direct skin and eye contact with chemicals and particulates.
- Accidental ingestion of chemicals and particulates

6.3.1 Exposure Via Inhalation

VOCs that may be present in groundwater and soil are potential hazards for exposure via inhalation. Chemical exposure via inhalation of volatilized chemicals will be mitigated through the use of common sense, air monitoring for chemical vapors using a photoionization detector, and PPE. To minimize potential exposures from inhalation, site personnel shall not be downwind of an impacted area at which intrusive work (i.e. drilling etc.) is being performed. Soil and groundwater samples must not be smelled in an attempt to confirm the presence or absence of contaminants. PPE shall be utilized as necessary (based on specific action levels) to prevent chemical exposure in excess of the exposure limits listed in Table 2. Air monitoring shall be conducted in all work areas as described in the next section. Use of PPE will be initiated based on monitoring and action levels discussed in Section 7.2.

6.3.2 Exposure Via Ingestion

Chemical exposure via ingestion shall be mitigated through the use of the following personal hygiene practices:

- Eating, drinking, and using tobacco is prohibited in the work area.
- All workers are required to wash their hands and face prior to consuming food, beverages, and/or tobacco products.

6.3.3 Exposure Via Dermal Contact

Chemical exposure via dermal contact will be mitigated through the use of common sense and PPE appropriate to the tasks and hazards. Dermal exposure is possible during the performance of the following tasks:

- Drilling and installing wells;
- Development and sampling of wells;
- Sampling of investigative derived waste (IDW).

Care shall be taken to minimize direct contact with contaminated liquids and solids. The base level of protection required to prevent chemical exposure via dermal contact will include chemically resistant gloves, safety glasses with side protection, and disposable coveralls.

The specific type of gloves and coveralls (i.e., nitrile, natural rubber, Tyvek, or Saranex) will be selected based on the manufacturer's data concerning each material's resistance to chemical penetration when exposed to the chemicals of concern at the Site. Nitrile gloves can be used for site activities. It is unlikely that direct exposure to pure product will be encountered and, therefore, the exchange of nitrile gloves every hour should be acceptable. If pure product is encountered and handled however, according to the Comprehensive Guide to Chemical Resistant Best Gloves (<http://www.chemrest.com/>), the gloves should be changed out within 9 minutes of contact.

All PPE will be approved by the SSO before beginning field activities.

6.4 Biological Hazards

There is a possibility that biological hazards may be encountered during site activities. The most probable biological hazard to site workers, based on existing site information, is injury due to biological vectors, such as stings from insects, or bites from snakes. There is also the possibility of site workers encountering blood-borne pathogens (i.e. Hanta Virus or Lyme Disease), either from direct contact with biological vectors (i.e. rodents or ticks), or from infection associated with cuts,

abrasions, or puncture wounds sustained while manning heavy equipment. A blood-borne pathogen kit and first aid kit will be maintained at each site as a first response action. Depending on the severity of an injury sustained because of a biological vector, additional medical assistance may be sought by the SSO.

6.4.1 Bees and Other Stinging Insects

Bees and other stinging insects may be encountered almost anywhere and may present a serious hazard, particularly to people who are allergic. During the tailgate safety meeting, identify any workers allergic to bees or other insects, and if they carry an epinephrine shot with them. If so, review with them the procedures for administering the epinephrine shot. Watch for and avoid nests. Keep exposed skin to a minimum. If a worker gets stung, determine if a stinger is present. If so, remove it carefully with tweezers, being careful not to squeeze the venom sack. Wash and disinfect the wound, cover it, and apply ice. Watch for allergic reaction. Seek medical attention if a reaction develops.

6.4.2 Snakes

Snakes typically are found in underbrush and tall grassy areas. If you encounter a snake, stay calm and look around – there may be other snakes. Turn around and walk away on the same path you used to approach the area. If a snake bites a person, wash and immobilize the injured area, keeping it lower than the heart, if possible. Seek medical attention immediately. DO NOT apply ice, cut the wound, or apply a tourniquet. Try to identify the type of snake: note color, size, patterns, and markings. Take a picture if possible.

6.4.3 Blood-borne Pathogens

Exposure to blood-borne pathogens may occur when rendering first aid or CPR, or when coming into contact with blood or other bodily fluids. Bloodborne pathogens (BBP) include such diseases as Hepatitis B and C or HIV. Exposure can be a concern at a job site for employees who have been designated to render first aid must do so and body fluid is present.

If field personnel are designated to provide first aid, an Exposure Control Plan will be developed and implemented. In addition, these employees will be offered the Hepatitis B vaccination series and trained in accordance to 29 CFR 1910.1030, Occupational Exposure to Blood borne Pathogens.

To avoid occupational exposure, all on-site personnel who are designated to provide first aid will consider any body fluid as contaminated when rendering first aid and will wear, at a minimum, gloves and eye protection. Gloves will also be worn when handling contaminated first aid supplies and the supplies will be discarded as directed in the Exposure Control Plan.

7. Monitoring of Hazard Controls

This section provides administrative work practices for monitoring the environment to reduce or eliminate potential chemical hazards. These practices and controls are to be implemented by the party in control of either the site or the particular hazard.

7.1 Air Monitoring

Air monitoring activities will be performed during all drilling activities. ARCADIS' SSO will be responsible for all site-monitoring activities, including monitoring with respect to its employees as well as its subcontractors.

7.1.1 Volatile Organic Compounds

Air monitoring will be conducted at this site during all planned field activities in order to ensure that the workers are appropriately protected from the identified potential chemical hazards. An intrinsically safe photoionization detector (PID) will be used to monitor ambient air for total VOCs during all well installation activities. These instruments are designed to measure trace quantities of total VOCs in air, and depending on the make and model, typically have a sensitivity range of one part per million (ppm). The PID will be calibrated each day, before field use, and calibration records will be kept.

7.1.2 Combustible Vapors

If combustible gases or vapors are encountered, a combination meter (e.g., combustible gas indicator [CGI], and oxygen meter) may be used to monitor for the presence of oxygen, flammable/explosive gases and vapors (such as methane). The SSO shall monitor the exclusion zone to ensure that 20 percent of the lower explosive limit (LEL) is not exceeded for the Contaminants of Concern (COCs). If explosive vapors are detected at a reading of 20 percent of the LEL or greater, work will be discontinued and the area evacuated until vapor concentrations drop below 20 percent of the LEL.

Following evacuation, the cause of the potentially explosive atmosphere shall be identified, and changes in the work plan established as needed.

The southwestern portion of the OU-2 is located in Santa Fe Springs where oil production is ongoing in vicinity of the proposed fieldwork. It is possible methane and/or hydrogen sulfide could be present in subsurface soil.

7.1.3 Dust Monitoring

Significant dust emissions are not anticipated at the site as a consequence of proposed field activities. Should conditions change and dust become a safety and health concern, the SSO will evaluate the situation and make appropriate arrangements for control of these emissions.

7.2 Action Levels

The following action level procedures have been established for all planned field activities to evaluate whether actual field conditions will require an upgrade in the level of PPE. Table 2 Exposure Levels for the Constituents of Concern provides a summary of established action levels at each site based on specific compounds that may be encountered.

Prior to the start of each day's activities, background readings for VOCs in the immediate work area shall be taken using an intrinsically safe PID. An action level of 5 ppm over a sustained period of 10 minutes in the workers' breathing zone has been established based on the potential presence of 1,2 DCA, TCE and PCE. If the PID readings remain over 5 ppm for an extended period of time, work will be discontinued, the work area will be permitted to vent, and the workers will be moved to an area up wind. Work will not resume until the VOC concentrations fall below the 5 ppm action level. If the concentration of VOCs does not fall below 5 ppm after 10 minutes, the work will resume with the level of protection upgraded to Level C.

Should the PID readings meet or exceed 50 ppm for a sustained period of 10 minutes, then work will be discontinued; workers will be moved upwind; and the work area will be permitted to vent until the PID readings are less than 50 ppm. If after 10 minutes of venting, the PID readings are still 50 ppm or greater, work can resume with workers upgraded to supply air (Level B protection).

If suspected based on work location and other indicators (e.g., odor), hydrogen sulfide will be measured using a hydrogen sulfide meter. If the readings exceed 1 ppm, workers will be removed and the work area allowed to vent. Upgrades based on hydrogen sulfide values are not expected, but if hydrogen sulfide readings in the Operator Breathing Zone occur above 1 ppm for greater than 10 minutes, the workers will use Level B, supplied air respiratory protection.

7.3 Levels of Protection

Based upon the hazard evaluation results, all tasks will be performed in Level D protection. In the event that the established action levels are exceeded, the level of protection will be upgraded to Level C. The following is a description of the personal protective equipment required for each level:

Work Activity	Required Initial Level of Protection
General Site Work	Level D
Drilling	Level D
Well Development Water	Level D
Groundwater Sampling	Level D

The site manager (SM) and the SSO shall have the authority to establish initial protection levels for those activities not specified, and increase or decrease levels of protection, based on the results of the site monitoring and sampling. For example, if established action levels are exceeded, the level of protection may be upgraded to Level C or Level B.

The following is a description of the PPE required for each level:

Level D

- Hard hat
- Disposable coveralls (optional)
- Safety glasses with side protection, goggles, or face shield
- Steel-toe and shank, chemical-resistant boots
- Chemical-resistant gloves

- Hearing protection with a noise reduction rating (NRR) of 33 dBA or greater

Level C

- Safety glasses with side protection, goggles, or face shield
- Hard hat
- Disposable coveralls
- Full face air purifying respirator equipped with a combination cartridge rated for organic vapors, dusts and mists, and radionuclides
- Steel-toe and shank, chemical-resistant boots
- Chemical-resistant gloves
- Hearing protection with a noise reduction rating (NRR) of 33 decibels or greater

Level B

- Safety glasses with side protection, goggles, or face shield
- Hard hat
- Disposable coveralls
- Supplied air respirator
- Steel-toe and shank, chemical-resistant boots
- Chemical-resistant gloves
- Hearing protection with a noise reduction rating (NRR) of 33 decibels or greater

8. Safe Work Practices

- All ARCADIS site personnel will be participants of the company's health and safety program, which includes 40 hours of initial training, annual 8-hour refresher training. ARCADIS personnel acting in a supervisory capacity will have completed 8-hour manager and supervisor training.
- All ARCADIS site personnel are participants of the company's medical surveillance program. Personnel requiring respiratory protection will have a current medical clearance to wear a respirator and a current quantitative fit test meeting the requirements set forth in OSHA's 29CFR1910.134 Respiratory Protection Standard.

- A copy of the HASP will be available for reference at the Site during the planned field activities. Site visitors will be required to sign the Site Visitors Log.
- A pre-entry, tailgate safety meeting will be conducted and recorded on a standardized form in prior to the start of each day's activities to discuss the associated hazards.
- All underground utilities and structures will be marked out and cleared before any ground intrusive work begins.
- The SM and the SSO will inform all subcontractors of the potential hazards associated with the Site and the planned field activities. A copy of the HASP will be made available for their review.
- No eating, drinking, or smoking will be permitted in the work and support zones.
- No sources of ignition, such as matches or lighters, will be permitted in the work and support zones.
- Material Safety Data Sheets (MSDSs) shall be on site for any chemicals that ARCADIS or its subcontractors brings onto the site. In addition, subcontractors shall maintain reference copies of MSDSs for all chemicals brought to the site. One copy of all subcontractors' MSDSs shall be provided to the SM.
- During hazardous weather conditions, such as lightning and thunderstorms, work will cease immediately.
- Pregnant women may work in the support areas. However, they shall be restricted from entering the exclusion zone or contamination-reduction zone (CRZ). Upon entering the site, all pregnant women shall discuss their condition with the SM or SSO to obtain a "Declared Pregnant Worker" status.

9. Site Control

Entrance to the actual work area is limited to authorized personnel only. The SSO will determine and identify the following areas of the work site. These areas will be divided into three zones designated as the exclusion zone, the contamination reduction zone (CRZ), and the support zone. The SSO will also specify the equipment, operations, and personnel to occupy these controlled areas. As drilling at a particular

location is likely to extend beyond one day, security guards will be hired to secure the work area overnight.

9.1 Exclusion Zone

The exclusion zone is the zone where contamination exists or could occur. All personnel working in the exclusion zone will wear the prescribed level of protection. An entry and exit checkpoint will be visually defined at the periphery of the exclusion zone to regulate the flow of personnel and equipment into and out of the zone. Personnel who have not met the medical monitoring and training criteria set forth in this HASP are not permitted to enter the exclusion zone. In addition, pregnant women shall not be allowed to enter the exclusion zone or CRZ under any circumstances.

A visually defined exclusion zone will be established around work areas in which encountering hazardous substances is probable. When established, this zone will be of sufficient size to contain all work activities and resultant waste production. Temporary markers (e.g., traffic cones, barricades, and/or barricade tape) shall be used to clearly delineate the CRZ and other select areas of the Site.

9.2 Contamination Reduction Zone (CRZ)

The area between the exclusion zone and the support zone is the CRZ. This zone provides a transition between a contaminated area (exclusion zone) and non-contaminated area (support zone). The CRZ serves as a buffer to further reduce the possibility of the clean support zone becoming contaminated. It provides additional assurance that the physical transfer of contaminated substances on personnel, equipment, or in the air is limited through a combination of decontamination, distance between exclusion and support zones, air dilution, zone restrictions, and work functions. Decontamination of personnel and sampling equipment will be performed in the contamination-reduction corridor (CRC), which will be situated within the CRZ. The CRC will be established as the entry and exit points to the defined work areas.

All tools, construction equipment, heavy equipment, and drilling equipment shall be decontaminated upon conclusion of site activities before any equipment leaves the CRZ. This measure is to prevent impacted equipment from leaving the CRZ and potentially affecting previously non-impacted areas, or impacting unsuspecting personnel. All subcontractors shall be responsible for decontaminating and scanning their own equipment. However, the SM or the SSO shall check said tools or equipment for quality control measures.

9.3 Support Zone

The support zone is the location of the administrative and other support functions needed to keep the operations in the Exclusion and CRZ running smoothly. Any function that cannot or need not be performed in a hazardous (or potentially hazardous) environment should be performed here. The Site Manager posted should be present in the Support Zone. Personnel may wear normal work clothes in the support zone. Any potentially contaminated clothing, equipment and samples must remain in the CRZ until decontaminated.

The support zone should be upwind of and in the line of sight to all activities in the exclusion zone.

10. Decontamination

All personnel performing work tasks in the work areas must pass through the CRZ decontamination procedure, regardless of the work task or protection used. The equipment decontamination pack is the primary corridor for passing between the exclusion and support zones. All equipment and tools used within the work area will also undergo decontamination. Final inspection of the equipment prior to leaving the work area is the responsibility of the SSO. The level of decontamination is commensurate with the level of hazards encountered, or anticipated.

10.1 Personnel

The decontamination procedure discussed below will be employed for those field activities requiring Level B and Level C protection. A similar procedure, with two fewer stations (Stations 4 and 6), will be used by personnel requiring Level D protection.

Station 1: Segregated Equipment Drop

Equipment used in the exclusion zone (tools, monitoring equipment, radios, clipboards, etc.) will be deposited on plastic drop cloths or in different containers with plastic liners. Tools and devices will be washed/wiped in a detergent solution and rinsed with clean water, then stored or serviced for reuse. Tools and similar field equipment may require a high-temperature water/stream wash. This station shall be located adjacent to the CRZ decontamination line.

Station 2: Wash and Rinse Outer Garment, Boots, and Gloves

Outer boots and gloves will be scrubbed with a decontamination solution, consisting of detergent and water. Gloves, boots, and garment will be rinsed with a hand-pump spray bottle or in a plastic bucket or tub.

Station 3: Removal of Outer Gloves

Outer gloves and any accompanying tape will be removed. Tape and disposable gloves should be placed in a container with a plastic liner. Reusable gloves will be cleaned and stored for future use.

Station 4: Cartridge/Bottle Change

If a worker leaves the exclusion zone to change respirator cartridges or supplied air bottles, Station 4 must be the last step in the decontamination procedure. After the worker's cartridges/bottles have been exchanged, the outer glove and boot covers are donned and joints taped, if required. The worker may then return to the exclusion zone.

Station 5: Removal of Boots and Outer Garment

Boots and outer garment will be removed. The outer, disposable, chemical-resistant garment should be deposited in a plastic-lined container. Reusable protective garments will be removed and stored for future use.

Station 6: Removal of Respiratory Protection

The respirator face piece will be removed, and the respirator will be placed in a plastic-lined container for decontamination.

10.2 Equipment and Vehicles

Equipment will be washed with decontamination solution (i.e., detergent and water), rinsed with clean water, and if required, steam cleaned to the satisfaction of the SSO prior to reuse. Vehicles will be decontaminated in a designated area. Support vehicles will be decontaminated as deemed necessary by the SSO.

10.3 Decontamination Personnel

Personnel working the CRZ will wear, at a minimum, the same level of protection as the workers in the Exclusion Zone. In addition, face shields will be worn rather than safety glasses or goggles to protect personnel against splashing.

10.4 Decontamination Waste Disposal

Solid wastes (discarded protective clothing, tape, etc.) will be containerized and disposed of in an approved manner.

10.5 Equipment Needs

The following equipment may be used during the decontamination procedure:

Station 1:

- Plastic drop cloths.
- Plastic 30- or 50-gallon containers.

Station 2:

- Hand-operated garden-type sprayers.
- Large tubs or wash containers (30- to 50-gallon capacity).
- Plastic buckets
- Brushes.
- Decontamination solution.
 - (1) Commercially available detergent.

Station 3:

- Plastic liners.
- Plastic containers (30- to 50-gallon capacity).

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Omega Chemical
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Station 4:

- Duct tape.
- Respirator cartridges.
- Supplied air bottles.

Station 5:

- Plastic liners.
- Plastic containers (30- to 50-gallon capacity).
- Detergent and/or boric acid for decontamination of respirators.

Station 6:

- Plastic liners.
- Plastic containers (30- to 50-gallon capacity).
- Bench
- Rack for boots.

Other Equipment:

- Hand-operated garden-type hose sprayers or garden hose for vehicle and equipment washing and rinsing.
- Steam cleaner.
- Potable water supply.
- Washbasins.

10.6 Contaminant Containment

A housekeeping program will be implemented during the course of the work tasks to avoid the spread of any contaminants beyond the exclusion zone. The housekeeping program will include the following:

Periodic policing of the work areas for debris, including paper products, cans, etc.

Periodic changing of wash and rinse water for hands, face, and equipment.

Periodic removal of all garbage bags and containers used to dispose of disposable clothing. Contaminated materials will be disposed of in an approved manner.

11. Emergency Response Plan

11.1 Pre-Emergency Planning

The SSO will perform the following applicable pre-emergency planning tasks before starting field activities and coordinates emergency response with ARCADIS on-site subcontractors and local emergency service providers, as appropriate.

- *Review the facility emergency and contingency plans where applicable. Field activities will not be performed at one specific location. Most of the activities will be performed in public rights of way. When work is performed on private property, however, this task must be performed.*
- *Determine what on-site communication equipment is available (e.g., two-way radio, air horn). (When work is performed on private property)*
- *Determine what off-site communication equipment is needed (e.g. nearest telephone, cell phone).*
- *Confirm and post emergency telephone numbers, evacuation routes, assembly areas, and route to hospital – communicate this information to the on-site personnel.*
- *Review changed site conditions, on-site operations, and personnel availability in relation to emergency response procedures.*
- *Where appropriate and acceptable to the client, inform emergency room and ambulance and emergency response teams of anticipated types of site emergencies.*
- *Designate one vehicle as the emergency vehicle. Place hospital directions and map inside. Keep keys in the ignition during field activities.*
- *Inventory and check site emergency equipment, supplies, and potable water.*
- *Communicate emergency procedures for personnel injury, exposures, fires, explosions, and releases.*
- *Rehearse the emergency response plan before site activities begin, including driving route to hospitals.*

- Brief new workers on the emergency response plan.

11.2 Emergency Equipment and Supplies

For each location, the SSO should mark the locations of emergency equipment on the site map and post in the control center. The SSO should also review emergency equipment location with all field personnel.

<u>Emergency Equipment and Supplies</u>	<u>Location</u>
20-LB fire extinguisher (A, B, and C class)	Support Zone/Heavy Equipment
First Aid Kit	Support Zone/Field Vehicle
Eye Wash	Support & Decon Zone/Field Vehicle
Potable Water	Support & Decon Zone/Field Vehicle
Blood-borne-pathogen kit	Support/Field Vehicle
Additional equipment	

11.3 Incident Response

In case of fire, explosion, or chemical release, the following actions should be taken:

- Shut down field operations and immediately evacuate work area to pre-established assembly area.
- Notify appropriate response personnel.
- Account for personnel at the designated assembly area.
- Assess the need for site evacuation, first aid. Evacuate as warranted.

Work shall not resume at the site until the ARCADIS Project Manager, Health and Safety Manager, and Site Manager have been notified of the emergency and they agree that the Site is safe for continued work. Injured personnel will be removed from the exclusion zone or other work area by coworkers (if possible) for transport to the hospital. The SSO will accompany the injured worker and perform (if necessary) a contamination survey of the ambulance/vehicle after the individual is at the hospital for treatment.

In the case of an emergency, verbal communications may be difficult due to PPE and noise. A universal set of hand signals, listed below, will then be used.

- Hand gripping throat: Can't breathe
- Grip partner's wrist or place hands around waist: Leave work area immediately
- Hand on top of head: Need assistance
- Thumbs up: Okay; I'm all right
- Thumbs down: No; Negative

Note that small fires or spills posing minimal safety or health hazards may be controlled and managed in the field, and do not necessarily require evacuation. The determination of the need for evacuation will be made by the SSO based on site conditions.

11.4 Emergency Medical Treatment

The procedures listed below may also be applied to non-emergency incidents. Injuries and illnesses, including overexposure to contaminants, must be reported to Human Resources. If there is doubt about whether medical treatment is necessary, or if the injured person is reluctant to accept medical treatment, contact the ARCADIS Project Manager. During non-emergencies, follow these procedures as appropriate.

- Prevent further injury
- Notify appropriate emergency response authorities listed in Section xx (typically 911).
- Injured personnel will be removed from the exclusion zone or other work area by coworkers (if possible) for transport to the hospital. Perform decontamination where feasible; lifesaving and first aid or medical treatment take priority.
- Initiate first aid and CPR where appropriate and feasible.
- The Emergency Response Commander will assume charge during a medical emergency until the ambulance arrives or until the injured person is admitted to the emergency room. The SSO will accompany the injured worker and perform (if necessary) a contamination survey of the ambulance/vehicle after the individual is at the hospital for treatment.

- Notify the ARCADIS SM or SSO about the injury. State the situation, give your name and telephone number where you can be reached. Provide the name of the injured person, the extent of the injury or exposure, and the name and location of the medical facility where the injured person was taken.
- Complete an Accident/Illness Report Form and submit to the SSO as indicated in Section 11.5.

11.5 Injury Reporting

All job-related injuries and illnesses will be reported to the SM or SSO. If medical attention is needed, the injured worker will be decontaminated, if possible, prior to leaving the Site. The SM or SSO will investigate the cause of the accident, and corrective measures will be taken before the work can resume. It will be the responsibility of the SSO to complete the accident reporting form, OSHA 101, for all injuries. The completed OSHA 101 form should be forwarded to ARCADIS' Fullerton office and the Corporate Administrator of Health and Safety, within 6 days for recording into the OSHA 200 log. In the event of a fatality or three or more workers hospitalized as a result of a single incident, the SM will contact the office health and safety manager immediately for OSHA reporting purposes.

11.6 Project Personnel Emergency Telephone Numbers

John Johnsen, Project Manager, ARCADIS,
(714) 278-0992 x3051 (Office)
(818) 360-6770 (SFV Office)
(562) 221-2270 (Cellular)

Kevin Thomas, Health and Safety Officer, ARCADIS,
(714) 278-0992 x3060 (Office)

11.7 Directions to the Hospital

The hospital is just west of the intersection of Whittier Boulevard and Washington Boulevard in Whittier, California. See Figure 1 for hospital location.

ARCADIS G&M Employees

LOG OF ARCADIS PROJECT PERSONNEL

[illegible]

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Whittier, CA

Contractors and Subcontractors

Copies of this document will be provided to contractors and subcontractors who may be affected by activities addressed herein. Contractors and subcontractors must comply with this document (and/or their own HASP if it is equally or more stringent than the ARCADIS G&M HASP), applicable OSHA, EPA, and local government rules and regulations. The contractors' and subcontractors' signatures acknowledge their understanding of the HASP and agreeing to comply with the procedures presented therein.

LOG OF CONTRACTOR AND SUBCONTRACTOR PROJECT PERSONNEL

[illegible]

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Omega Chemical
Operable Unit 2,
Whittier, CA

VISITORS: It is ARCADIS G&M's policy that visitors must furnish their own PPE. Visitors are required to sign the Visitor Log and comply with guidelines, rules, and procedures presented in this HASP. If the visitor represents a regulatory agency concerned with site health and safety issues, the SSO must immediately notify the Project Director.

VISITOR LOG

Date of

[illegible]

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Health and Safety Plan

Omega Chemical
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Whittier, CA

HEALTH AND SAFETY MEETINGS: Project personnel must receive initial health and safety orientation. Thereafter, a brief tailgate safety meeting is required as deemed necessary by the SSO. Health and safety meetings will be held at least once every week or when risks and/or hazards change.

HEALTH AND SAFETY MEETING LOG

Name of

[illegible]

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Health and Safety Plan

Omega Chemical
Operable Unit 2,
Whittier, CA

HEALTH AND SAFETY MEETINGS: Project personnel must receive initial health and safety orientation. Thereafter, a brief tailgate safety meeting is required as deemed necessary by the SSO. Health and safety meetings will be held at least once every week or when risks and/or hazards change.

HEALTH AND SAFETY MEETING LOG

[illegible]

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Health and Safety Plan

Omega Chemical
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Whittier, CA

HEALTH AND SAFETY MEETINGS: Project personnel must receive initial health and safety orientation. Thereafter, a brief tailgate safety meeting is required as deemed necessary by the SSO. Health and safety meetings will be held at least once every week or when risks and/or hazards change.

HEALTH AND SAFETY MEETING LOG

[illegible]

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Tables

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Table 1. Task Hazard Analysis

Potential Hazard	Mark Borings	Clear Borings / Geophysical	Water Sampling	Drilling and Well Installation	Develop and Sample Groundwater	Surveying	IDW Waste Management
Physical Hazards							
Slip/Trip/Fall	•	•	•	•	•	•	•
Flying Debris or Objects				•			
Noise > 80 dBA				•	•		
Heavy Loads (back injury)		•	•	•	•		•
Vehicle Traffic	•	•	•	•	•	•	•
Environmental Hazards							
Heat Stress			•	•	•		•
Cold Stress	°	°	°	°	°	°	°
Chemical Hazards							
Inhalation			•	•	•		•
Dermal Contact			•	•	•		•
Ingestion			•	•	•		•
Splash			•	•	•		•
Biological Hazards							
Bees / Stinging Insects	°	°	°	°	°	°	°
Snakes							
Rodents (Hantavirus)							
Ticks (Lyme Disease)							

• indicates exposure to hazard possible and likely;

° indicates exposure to hazard possible with low to moderate likelihood

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Table 2. Exposure Limits for the Constituents of Concern

Chemical	Description	IP (eV)	OSHA (ppm)			NIOSH REL (ppm)	IDLH (ppm)	LEL (ppm)	Exposure Route	Target Organs	Symptoms
			PEL-TWA	STEL	Ceiling						
Tetrachloroethylene (PCE)	Colorless liquid with a mild, chloroform-like odor	9.32	100		200	Ca	150 Ca	NA	Inh, abs, ing, eye	Eyes, skin, resp, liver, kidney, cns	Irritation to eyes, skin, nose, throat, resp. sys; nausea; flush face and neck; dizziness; headache, drowsiness; liver damage
Trichloroethylene (TCE)	Colorless liquid (unless dyed blue) with a chloroform-like odor	9.45	100		200	Ca	1000 Ca	80,000	Inh, abs, ing, eye	Eyes, skin, resp. sys., heart, liver, kidneys, cns	Irritation to eyes, skin; headache, visual disturbance, weakness, exhaustion, dizziness, tremors, nausea, vomiting, skin rash, cardiac arrhythmias; liver damage.
1,2 Dichloroethylene (1,2 DCE)	Colorless liquid with a slightly acrid, chloroform-like odor.	9.65	200			200	1000	56,000	Inh, ing, abs, eye	Eyes, resp. sys., cns	Irritation to eyes, resp. sys; cns depression
1,1 Dichloroethylene (1,1 DCE)	Colorless liquid or gas (above 89 deg F), with a mild, sweet, chloroform-like odor.	10	None			Ca	Ca	65,000	Inh, abs, ing, eye	Eyes, skin, resp. sys., cns, liver, kidneys	Irritation to eyes, skin and throat; dizziness, headache, nausea, breathing difficulty; liver and kidney disturbance.
Freon 11	Colorless to water-white liquid, nearly odorless.	11.77	1000			1000	2000	NA	Inh, ing, abs, eye	Skin, resp. sys, cardio sys.	Incoordination, tremors; skin rash; cardiac arrhythmias, cardiac arrest; asphyxia
Freon 113	Colorless to water-white liquid with an odor like carbon tetrachloride at high concentrations.	11.99	1000			1000	2000	NA	Inh, ing, abs, eye	Skin, cns, cardio sys.	Irritation to skin, throat; drowsiness; skin rash; cns depression, possible cardiac arrhythmias.
Chloroform	Colorless liquid with a pleasant odor.	11.42			50	2 Ca	500 Ca		Inh, abs, ing, eye	Liver, kidneys, heart, eyes, skin, cns	Irritation to eyes and skin; dizziness, mental dullness, nausea, confusion; headache, weakness and exhaustion; drowsiness; enlarged liver.
Toluene	Colorless liquid with a sweet, pungent, benzene-like odor.	8.82	200		300	100	500	11,000	Inh, abs, ing, eye	Eyes, skin, resp. sys, cns, liver, kidney	Irritation to eyes and nose; weakness and exhaustion; confusion, euphoria, dizziness, headache; dilated pupils, discharge of tears; anxiety, muscle fatigue; dermatitis, liver and kidney damage.
1,2 Dichloroethane (1,2 DCA)	Colorless liquid with a pleasant chloroform-like odor.	11.05	50		100	1 Ca	50 Ca	62,000	Inh, ing, abs, skin, eye	Eyes, skin, kidneys, liver, cns, cardio sys.	Irritation to skin, eyes and respiratory tract. Inhalation may cause lung oedema; cns depression; nausea; dermatitis; liver kidney and cardiovascular system damage.
Perchlorate											Diminished thyroid action, irritation to the eyes, skin and mucous membranes.
1,1,1-Trichloroethane (1,1,1 TCA)	Colorless liquid with a mild, chloroform-like odor	11	350			350	700	75,000	Inh, ing, abs, eye	Eyes, skin, chs, cardio sys, liver	Irritation to eyes and skin; headache, weakness, cns depression, poor equilibrium; cardiac arrhythmias; liver damage.
Chromium (as Cr ⁺² and Cr ⁺³)	Appearance and odor vary depending upon specific compound		0.5 mg/m ³			0.5 mg/m ³	25 mg/m ³		Inh, ing, abs, eye	Eyes, skin	Irritation to eyes, sensitization dermatitis
Chromic acid (Cr ⁺⁶)	Dark red, odorless flakes or powder				0.1 mg/m ³	0.001 mg/m ³ Ca	15 mg/m ³ Ca		Inh, ing, abs, eye	Blood, resp sys, liver, kidneys, eyes, skin	Irritation to resp sys; nasal septum perforation; liver and kidney damage; leukocytosis; leukopenia, eosinophilia; eye injury, conjunctivitis; skin ulcer, sensitization dermatitis.
Hydrogen sulfide	Colorless gas with strong odor of rotten eggs	10.46	10 ppm		20 ppm	10 ppm	100	4%	Inh, skin, eye	Eyes, resp sys, cns	Irritation to eyes, respiratory systemapnea, coma, convulsions, photophobia, dizziness, headache
Methane	Colorless gas with no odor		1000 ppm					5%	Inh, skin, eyes	Eyes, resp sys, cns	cns depression, cardiac sensitization
Minimum		8.82	50	0	50	1	50	11000			
Maximum		11.99									

ppm parts per million by volume, as measured by a photoionization detector (PID)
mg/m³ milligrams per cubic meter
IP Ionization potential, measured in electronVolts (eV). Used to determine proper PID lamp for measuring airborne concentrations
PEL-TWA OSHA permissible exposure limit, a time-weighted average (TWA) for an 8-hour period in a 40-hr workweek. Enforcable by law.
STEL OSHA Short term exposure; measured over a 15-minute period
Ceiling OSHA ceiling concentration - must not be exceeded during any part of the workday.
NIOSH REL NIOSH recommended exposure limit: a TWA for up to a 10-hr workday during a 40-hr workweek.
IDLH NIOSH Immediately Dangerous to Life or Health. Concentrations that pose an (airborne) exposure condition likely to cause death or immediate or delayed permanent adverse health effects
Exposure Routes: Inhalation (inh), ingestion (ing), skin absorption (abs), absorption through eyes (eyes).
Target Organs: Central Nervous System (cns), Respiratory System (resp sys), Cardiovascular System (cardio sys)

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Table 3. Summary of Action Levels

Air Monitoring	Action Levels	Actions To Take
PID Reading	<25 ppm	Remain in Level D protection. Respirator not required
PID Reading	≥25 ppm ¹	Let work area vent or upgrade to Level C protection. (respirator required)
LEL Reading	>10 %	Let work area vent
Hydrogen Sulfide Meter	>10 ppm	Let work area vent.

PID Photoionization detection equipment equipped with a 10.6 eV lamp.

ppm Parts per million.

¹ For 5 minutes sustained.

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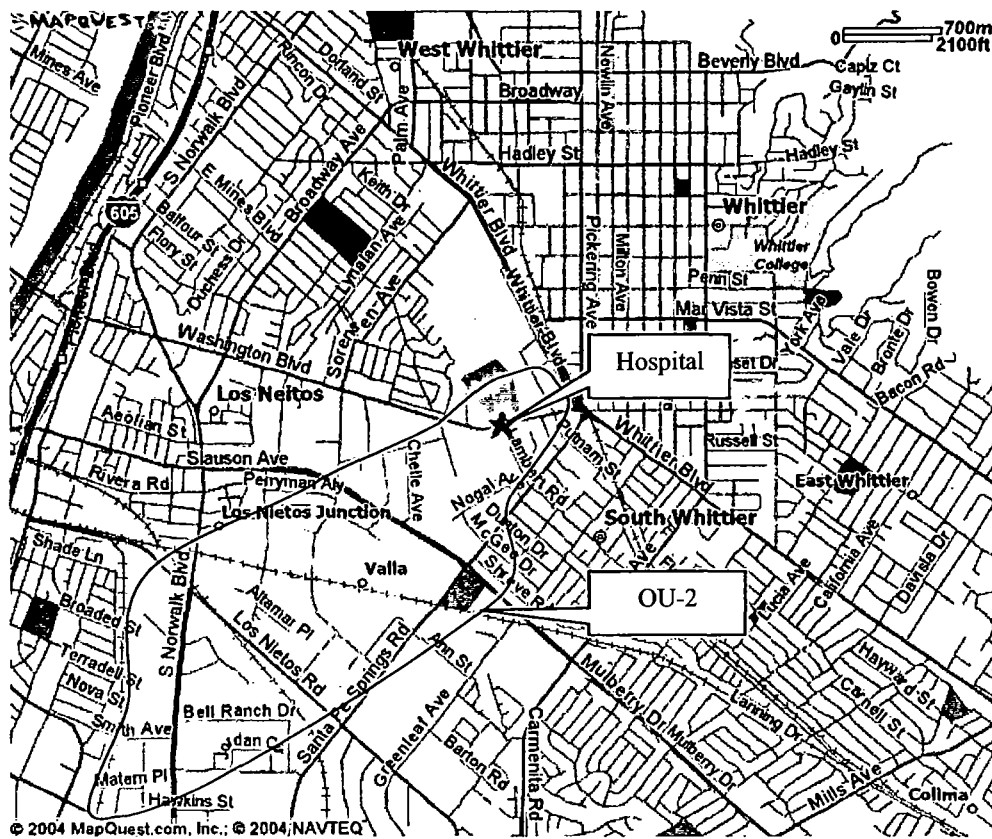
Figure

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Figure 1. Site and Hospital Location Map

Presbyterian Intercommunity Hospital
12401 Washington Blvd.
Whittier, California 90602

Phone Number: (562) 698-0811



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Appendix A

Material Safety Data Sheets

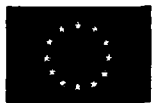
NIOSH Pocket Guide to Chemical Hazards

Ethylene dichloride		CAS 107-06-2
ClCH₂CH₂Cl		RTECS K10525000
Synonyms & Trade Names 1,2-Dichloroethane; Ethylene chloride; Glycol dichloride		DOT ID & Guide 1184 129
Exposure Limits	NIOSH REL: Ca TWA 1 ppm (4 mg/m ³) ST 2 ppm (8 mg/m ³) See Appendix A See Appendix C (Chloroethanes)	
	OSHA PEL†: TWA 50 ppm C 100 ppm 200 ppm [5-minute maximum peak in any 3 hours]	
IDLH Ca [50 ppm] See: 107062		Conversion 1 ppm = 4.05 mg/m ³
Physical Description Colorless liquid with a pleasant, chloroform-like odor. [Note: Decomposes slowly, becomes acidic & darkens in color.]		
MW: 99.0	BP: 182°F	FRZ: -32°F
VP: 64 mmHg	IP: 11.05 eV	Sp.Gr: 1.24
Fl.P: 56°F	UEL: 16%	LEL: 6.2%
Class IB Flammable Liquid: Fl.P. below 73°F and BP at or above 100°F.		
Incompatibilities & Reactivities Strong oxidizers & caustics; chemically-active metals such as magnesium or aluminum powder, sodium & potassium; liquid ammonia [Note: Decomposes to vinyl chloride & HCl above 1112°F.]		
Measurement Methods NIOSH 1003; OSHA 3 See: NMAM or OSHA Methods		
Personal Protection & Sanitation Skin: Prevent skin contact Eyes: Prevent eye contact Wash skin: When contaminated Remove: When wet (flammable) Change: No recommendation Provide: Eyewash, Quick drench		First Aid (See procedures) Eye: Irrigate immediately Skin: Soap wash promptly Breathing: Respiratory support Swallow: Medical attention immediately
Important additional information about respirator selection Respirator Recommendations NIOSH At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration: (APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode/ (APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus Escape: (APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister/Any appropriate escape-type, self-contained breathing apparatus		
Exposure Routes inhalation, ingestion, skin absorption, skin and/or eye contact		
Symptoms Irritation eyes, corneal opacity; central nervous system depression; nausea, vomiting; dermatitis; liver, kidney, cardiovascular system damage; [potential occupational carcinogen]		
Target Organs Eyes, skin, kidneys, liver, central nervous system, cardiovascular system		
Cancer Site [in animals: forestomach, mammary gland & circulatory system cancer]		
See also: INTRODUCTION See ICSC CARD: 0250 See MEDICAL TESTS: 0104		

International Chemical Safety Cards

1,2-DICHLOROETHANE

ICSC: 0250



Ethylene dichloride
1,2-Ethylene dichloride
Ethane dichloride
 $\text{ClCH}_2\text{CH}_2\text{Cl} / \text{C}_2\text{H}_4\text{Cl}_2$
Molecular mass: 98.96

ICSC # 0250
CAS # 107-06-2
RTECS # KI0525000
UN # 1184
EC # 602-012-00-7



TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Highly flammable. Gives off irritating or toxic fumes (or gases) in a fire.	NO open flames, NO sparks, and NO smoking.	Powder, water spray, foam, carbon dioxide.
EXPLOSION	Vapour/air mixtures are explosive.	Closed system, ventilation, explosion-proof electrical equipment and lighting. Prevent build-up of electrostatic charges (e.g., by grounding). Do NOT use compressed air for filling, discharging, or handling.	In case of fire: keep drums, etc., cool by spraying with water.
EXPOSURE		AVOID ALL CONTACT!	IN ALL CASES CONSULT A DOCTOR!
•INHALATION	Abdominal pain. Cough. Dizziness. Drowsiness. Headache. Nausea. Sore throat. Unconsciousness. Vomiting. Symptoms may be delayed (see Notes).	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Half-upright position. Artificial respiration if indicated. Refer for medical attention.
•SKIN	Redness.	Protective gloves.	Remove contaminated clothes. Rinse and then wash skin with water and soap. Refer for medical attention.
•EYES	Redness. Pain. Blurred vision.	Safety goggles, face shield, or eye protection in combination with breathing protection.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
•INGESTION	Abdominal cramps. Diarrhoea. (Further see Inhalation).	Do not eat, drink, or smoke during work. Wash hands before eating.	Give nothing to drink. Refer for medical attention.
SPILLAGE DISPOSAL		STORAGE	PACKAGING & LABELLING
Evacuate danger area! Collect leaking and spilled liquid in sealable containers as far as possible. Absorb remaining liquid in		Fireproof. Separated from strong oxidants, food and feedstuffs and other incompatible substances (see Chemical	Unbreakable packaging; put breakable packaging into closed unbreakable container. Do not transport with food and

sand or inert absorbent and remove to safe place. Do NOT wash away into sewer. (Extra personal protection: self-contained breathing apparatus).

Dangers). Cool. Dry.

feedstuffs.
Marine pollutant.
Note: E
F symbol
T symbol
R: 45-11-22-36/37/38
S: 53-45
UN Hazard Class: 3
UN Subsidiary Risks: 6.1
UN Packing Group: II

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0250

Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities (C) IPCS CEC 1994. No modifications to the International version have been made except to add the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

International Chemical Safety Cards

1,2-DICHLOROETHANE

ICSC: 0250

I M P O R T A N T D A T A	PHYSICAL STATE; APPEARANCE: COLOURLESS, VISCOUS LIQUID, WITH CHARACTERISTIC ODOUR. TURNS DARK ON EXPOSURE TO AIR, MOISTURE AND LIGHT.	ROUTES OF EXPOSURE: The substance can be absorbed into the body by inhalation of its vapour, through the skin and by ingestion.
	PHYSICAL DANGERS: The vapour is heavier than air and may travel along the ground; distant ignition possible. As a result of flow, agitation, etc., electrostatic charges can be generated.	INHALATION RISK: A harmful contamination of the air can be reached very quickly on evaporation of this substance at 20° C.
	CHEMICAL DANGERS: The substance decomposes on heating and on burning producing toxic and corrosive fumes including hydrogen chloride (ICSC 0163) and phosgene (ICSC 0007). Reacts violently with aluminium, alkali metals, alkali amides, ammonia, bases, strong oxidants. Attacks many metals in presence of water. Attacks plastic.	EFFECTS OF SHORT-TERM EXPOSURE: The vapour irritates the eyes, the skin and the respiratory tract. Inhalation of the vapour may cause lung oedema (see Notes). The substance may cause effects on the central nervous system, kidneys, liver, resulting in impaired functions.
	OCCUPATIONAL EXPOSURE LIMITS: TLV: 10 ppm; 40 mg/m ³ (as TWA) (ACGIH 1994-1995). OSHA PEL: TWA 50 ppm C 100 ppm 200 ppm 5-minute maximum peak in any 3 hours NIOSH REL: Ca TWA 1 ppm (4 mg/m ³) ST 2 ppm (8 mg/m ³) See Appendix A See Appendix C (Chloroethanes) NIOSH IDLH: Potential occupational carcinogen 50 ppm	EFFECTS OF LONG-TERM OR REPEATED EXPOSURE: Repeated or prolonged contact with skin may cause dermatitis. This substance is probably carcinogenic to humans.
	PHYSICAL PROPERTIES Boiling point: 83.5°C Melting point: -35.7°C Relative density (water = 1): 1.235 Solubility in water, g/100 ml: 0.87 Vapour pressure, kPa at 20°C: 8.7 Relative vapour density (air = 1): 3.42	Relative density of the vapour/air-mixture at 20°C (air = 1): 1.2 Flash point: 13°C c.c. Auto-ignition temperature: 413°C Explosive limits, vol% in air: 6.2-16 Octanol/water partition coefficient as log Pow: 1.48
ENVIRONMENTAL		

DATA	
NOTES	
Depending on the degree of exposure, periodic medical examination is indicated. The symptoms of lung oedema often do not become manifest until a few hours have passed and they are aggravated by physical effort. Rest and medical observation are therefore essential. Immediate administration of an appropriate spray, by a doctor or a person authorized by him/her, should be considered.	
Transport Emergency Card: TEC (R)-605 NFPA Code: H 2; F 3; R 0;	
ADDITIONAL INFORMATION	
ICSC: 0250.	1,2-DICHLOROETHANE
(C) IPCS, CEC, 1994	
IMPORTANT LEGAL NOTICE:	Neither NIOSH, the CEC or the IPCS nor any person acting on behalf of NIOSH, the CEC or the IPCS is responsible for the use which might be made of this information. This card contains the collective views of the IPCS Peer Review Committee and may not reflect in all cases all the detailed requirements included in national legislation on the subject. The user should verify compliance of the cards with the relevant legislation in the country of use. The only modifications made to produce the U.S. version is inclusion of the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

NIOSH Pocket Guide to Chemical Hazards

Tetrachloroethylene		CAS 127-18-4
$\text{Cl}_2\text{C}=\text{CCl}_2$		RTECS KX3850000
Synonyms & Trade Names Perchlorethylene, Perchloroethylene, Perk, Tetrachlorethylene		DOT ID & Guide 1897 160
Exposure Limits	NIOSH REL: Ca Minimize workplace exposure concentrations. See Appendix A	
	OSHA PEL†: TWA 100 ppm C 200 ppm 300 ppm (5-minute maximum peak in any 3-hours)	
IDLH Ca [150 ppm] See: 127184		Conversion 1 ppm = 6.78 mg/m ³
Physical Description Colorless liquid with a mild, chloroform-like odor.		
MW: 165.8	BP: 250°F	FRZ: -2°F
VP: 14 mmHg	IP: 9.32 eV	Sp.Gr: 1.62
F.I.P: NA	UEL: NA	LEL: NA
Noncombustible Liquid, but decomposes in a fire to hydrogen chloride and phosgene.		
Incompatibilities & Reactivities Strong oxidizers; chemically-active metals such as lithium, beryllium & barium; caustic soda; sodium hydroxide; potash		
Measurement Methods NIOSH 1003; OSHA 1001 See: NMAM or OSHA Methods		
Personal Protection & Sanitation Skin: Prevent skin contact Eyes: Prevent eye contact Wash skin: When contaminated Remove: When wet or contaminated Change: No recommendation Provide: Eyewash, Quick drench		First Aid (See procedures) Eye: Irrigate immediately Skin: Soap wash promptly Breathing: Respiratory support Swallow: Medical attention immediately
Important additional information about respirator selection Respirator Recommendations NIOSH At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration: (APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode/ (APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus Escape: (APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister/Any appropriate escape-type, self-contained breathing apparatus		
Exposure Routes inhalation, skin absorption, ingestion, skin and/or eye contact		
Symptoms Irritation eyes, skin, nose, throat, respiratory system; nausea; flush face, neck; dizziness, incoordination; headache, drowsiness; skin erythema (skin redness); liver damage; [potential occupational carcinogen]		
Target Organs Eyes, skin, respiratory system, liver, kidneys, central nervous system		
Cancer Site [in animals: liver tumors]		
See also: INTRODUCTION See ICSC CARD: 0076 See MEDICAL TESTS: 0179		

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NIOSH Pocket Guide to Chemical Hazards

Trichloroethylene		CAS 79-01-6
CICH=CCl₂		RTECS KX4550000
Synonyms & Trade Names Ethylene trichloride, TCE, Trichloroethene, Trilene		DOT ID & Guide 1710 160
Exposure Limits	NIOSH REL: Ca See Appendix A See Appendix C	
	OSHA PEL†: TWA 100 ppm C 200 ppm 300 ppm (5-minute maximum peak in any 2 hours)	
IDLH Ca [1000 ppm] See: 79016		Conversion 1 ppm = 5.37 mg/m ³
Physical Description Colorless liquid (unless dyed blue) with a chloroform-like odor.		
MW: 131.4	BP: 189°F	FRZ: -99°F
VP: 58 mmHg	IP: 9.45 eV	Sp.Gr: 1.46
FLP: ?	UEL(77°F): 10.5%	LEL(77°F): 8%
Combustible Liquid, but burns with difficulty.		
Incompatibilities & Reactivities Strong caustics & alkalis; chemically-active metals (such as barium, lithium, sodium, magnesium, titanium & beryllium)		
Measurement Methods NIOSH 1022, 3800; OSHA 1001 See: NMAM or OSHA Methods		
Personal Protection & Sanitation Skin: Prevent skin contact Eyes: Prevent eye contact Wash skin: When contaminated Remove: When wet or contaminated Change: No recommendation Provide: Eyewash, Quick drench		First Aid (See procedures) Eye: Irrigate immediately Skin: Soap wash promptly Breathing: Respiratory support Swallow: Medical attention immediately
Important additional information about respirator selection Respirator Recommendations NIOSH At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration: (APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode/ (APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus Escape: (APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister/Any appropriate escape-type, self-contained breathing apparatus		
Exposure Routes inhalation, skin absorption, ingestion, skin and/or eye contact		
Symptoms Irritation eyes, skin; headache, visual disturbance, lassitude (weakness, exhaustion), dizziness, tremor, drowsiness, nausea, vomiting; dermatitis; cardiac arrhythmias, paresthesia; liver injury; [potential occupational carcinogen]		
Target Organs Eyes, skin, respiratory system, heart, liver, kidneys, central nervous system		
Cancer Site [in animals: liver & kidney cancer]		
See also: INTRODUCTION See ICSC CARD: 0081 See MEDICAL TESTS: 0236		

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NIOSH Pocket Guide to Chemical Hazards

1,2-Dichloroethylene		CAS 540-59-0
ClCH=CHCl		RTECS KV9360000
Synonyms & Trade Names Acetylene dichloride, cis-Acetylene dichloride, trans-Acetylene dichloride, sym-Dichloroethylene		DOT ID & Guide 1150 132P
Exposure Limits	NIOSH REL: TWA 200 ppm (790 mg/m ³)	
	OSHA PEL: TWA 200 ppm (790 mg/m ³)	
IDLH 1000 ppm See: 540590		Conversion 1 ppm = 3.97 mg/m ³
Physical Description Colorless liquid (usually a mixture of the cis & trans isomers) with a slightly acrid, chloroform-like odor.		
MW: 97.0	BP: 118-140°F	FRZ: -57 to -115°F
VP: 180-265 mmHg	IP: 9.65 eV	Sp.Gr(77°F): 1.27
Fl.P: 36-39°F	UEL: 12.8%	LEL: 5.6%
Class IB Flammable Liquid: Fl.P. below 73°F and BP at or above 100°F.		
Incompatibilities & Reactivities Strong oxidizers, strong alkalis, potassium hydroxide, copper [Note: Usually contains inhibitors to prevent polymerization.]		
Measurement Methods NIOSH 1003; OSHA 7 See: NMAM or OSHA Methods		
Personal Protection & Sanitation Skin: Prevent skin contact Eyes: Prevent eye contact Wash skin: When contaminated Remove: When wet (flammable) Change: No recommendation		First Aid (See procedures) Eye: Irrigate immediately Skin: Soap wash promptly Breathing: Respiratory support Swallow: Medical attention immediately
Important additional information about respirator selection Respirator Recommendations NIOSH/OSHA Up to 2000 ppm: (APF = 25) Any supplied-air respirator operated in a continuous-flow mode ^E /(APF = 25) Any powered, air-purifying respirator with organic vapor cartridge(s) ^E /(APF = 50) Any chemical cartridge respirator with a full facepiece and organic vapor cartridge(s)/(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister/(APF = 50) Any self-contained breathing apparatus with a full facepiece/(APF = 50) Any supplied-air respirator with a full facepiece Emergency or planned entry into unknown concentrations or IDLH conditions: (APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode/(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus Escape: (APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister/Any appropriate escape-type, self-contained breathing apparatus		
Exposure Routes inhalation, ingestion, skin and/or eye contact		
Symptoms Irritation eyes, respiratory system; central nervous system depression		
Target Organs Eyes, respiratory system, central nervous system		
See also: INTRODUCTION See ICSC CARD: 0436		

NIOSH Pocket Guide to Chemical Hazards

Vinylidene chloride		CAS 75-35-4
$\text{CH}_2=\text{CCl}_2$		RTECS KV9275000
Synonyms & Trade Names 1,1-DCE; 1,1-Dichloroethene; 1,1-Dichloroethylene; VDC; Vinylidene chloride monomer; Vinylidene dichloride		DOT ID & Guide 1303 129P (inhibited)
Exposure Limits	NIOSH REL: Ca See Appendix A	
	OSHA PEL†: none	
IDLH Ca [N.D.] See: IDLH INDEX		Conversion
Physical Description Colorless liquid or gas (above 89°F) with a mild, sweet, chloroform-like odor.		
MW: 96.9	BP: 89°F	FRZ: -189°F
VP: 500 mmHg	IP: 10.00 eV	Sp.Gr: 1.21
FLP: -2°F	UEL: 15.5%	LEL: 6.5%
Class IA Flammable Liquid: FLP below 73°F and BP below 100°F.		
Incompatibilities & Reactivities Aluminum, sunlight, air, copper, heat [Note: Polymerization may occur if exposed to oxidizers, chlorosulfonic acid, nitric acid, or oleum. Inhibitors such as the monomethyl ether of hydroquinone are added to prevent polymerization.]		
Measurement Methods NIOSH 1015; OSHA 19 See: NMAM or OSHA Methods		
Personal Protection & Sanitation Skin: Prevent skin contact Eyes: Prevent eye contact Wash skin: When contaminated Remove: When wet (flammable) Change: No recommendation Provide: Eyewash, Quick drench		First Aid (See procedures) Eye: Irrigate immediately Skin: Soap flush immediately Breathing: Respiratory support Swallow: Medical attention immediately
Important additional information about respirator selection Respirator Recommendations NIOSH At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration: (APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode/ (APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus Escape: (APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister/Any appropriate escape-type, self-contained breathing apparatus		
Exposure Routes inhalation, skin absorption, ingestion, skin and/or eye contact		
Symptoms Irritation eyes, skin, throat; dizziness, headache, nausea, dyspnea (breathing difficulty); liver, kidney disturbance; pneumonitis; [potential occupational carcinogen]		
Target Organs Eyes, skin, respiratory system, central nervous system, liver, kidneys		
Cancer Site [in animals: liver & kidney tumors]		
See also: INTRODUCTION See ICSC CARD: 0083		

NIOSH Pocket Guide to Chemical Hazards

Fluorotrichloromethane		CAS 75-69-4	
CCl ₃ F		RTECS PB6125000	
Synonyms & Trade Names Freon® 11, Monofluorotrichloromethane, Refrigerant 11, Trichlorofluoromethane, Trichloromonofluoromethane		DOT ID & Guide	
Exposure Limits	NIOSH REL: C 1000 ppm (5600 mg/m ³)		
	OSHA PEL†: TWA 1000 ppm (5600 mg/m ³)		
IDLH 2000 ppm See: 75694		Conversion 1 ppm = 5.62 mg/m ³	
Physical Description Colorless to water-white, nearly odorless liquid or gas (above 75°F).			
MW: 137.4	BP: 75°F	FRZ: -168°F	Sol(75°F): 0.1%
VP: 690 mmHg	IP: 11.77 eV	RGasD: 4.74	Sp.Gr: 1.47 (Liquid at 75°F)
Fl.P: NA	UEL: NA	LEL: NA	
Noncombustible Liquid Nonflammable Gas			
Incompatibilities & Reactivities Chemically-active metals such as sodium, potassium, calcium, powdered aluminum, zinc, magnesium & lithium shavings; granular barium			
Measurement Methods NIOSH 1006 See: NMAM or OSHA Methods			
Personal Protection & Sanitation Skin: Prevent skin contact Eyes: Prevent eye contact Wash skin: No recommendation Remove: When wet or contaminated Change: No recommendation Provide: Eyewash, Quick drench		First Aid (See procedures) Eye: Irrigate immediately Skin: Water flush immediately Breathing: Respiratory support Swallow: Medical attention immediately	
Important additional information about respirator selection Respirator Recommendations NIOSH/OSHA Up to 2000 ppm: (APF = 10) Any supplied-air respirator/(APF = 50) Any self-contained breathing apparatus with a full facepiece Emergency or planned entry into unknown concentrations or IDLH conditions: (APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode/(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus Escape: (APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister/Any appropriate escape-type, self-contained breathing apparatus			
Exposure Routes inhalation, ingestion, skin and/or eye contact			
Symptoms Incoordination, tremor; dermatitis; cardiac arrhythmias, cardiac arrest; asphyxia; liquid: frostbite			
Target Organs Skin, respiratory system, cardiovascular system			
See also: INTRODUCTION See ICSC CARD: 0047			

NIOSH Pocket Guide to Chemical Hazards

1,1,2-Trichloro-1,2,2-trifluoroethane		CAS 76-13-1
CCl₂FCClF₂		RTECS KJ4000000
Synonyms & Trade Names Chlorofluorocarbon-113, CFC-113, Freon® 113, Genetron® 113, Halocarbon 113, Refrigerant 113, TTE		DOT ID & Guide
Exposure Limits	NIOSH REL: TWA 1000 ppm (7600 mg/m ³) ST 1250 ppm (9500 mg/m ³)	
	OSHA PEL†: TWA 1000 ppm (7600 mg/m ³)	
IDLH 2000 ppm See: 76131		Conversion 1 ppm = 7.67 mg/m ³
Physical Description Colorless to water-white liquid with an odor like carbon tetrachloride at high concentrations. [Note: A gas above 118°F.]		
MW: 187.4	BP: 118°F	FRZ: -31°F
VP: 285 mmHg	IP: 11.99 eV	Sp.Gr(77°F): 1.56
F.P.: ?	UEL: ?	LEL: ?
Noncombustible Liquid at ordinary temperatures, but the gas will ignite and burn weakly at 1256°F.		
Incompatibilities & Reactivities Chemically-active metals such as calcium, powdered aluminum, zinc, magnesium & beryllium [Note: Decomposes if in contact with alloys containing >2% magnesium.]		
Measurement Methods NIOSH 1020; OSHA 113 See: NMAM or OSHA Methods		
Personal Protection & Sanitation Skin: Prevent skin contact Eyes: Prevent eye contact Wash skin: When contaminated Remove: When wet or contaminated Change: No recommendation		First Aid (See procedures) Eye: Irrigate immediately Skin: Soap wash promptly Breathing: Respiratory support Swallow: Medical attention immediately
Important additional information about respirator selection Respirator Recommendations NIOSH/OSHA Up to 2000 ppm: (APF = 10) Any supplied-air respirator/(APF = 50) Any self-contained breathing apparatus with a full facepiece Emergency or planned entry into unknown concentrations or IDLH conditions: (APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode/(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus Escape: (APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister/Any appropriate escape-type, self-contained breathing apparatus		
Exposure Routes inhalation, ingestion, skin and/or eye contact		
Symptoms Irritation skin, throat, drowsiness, dermatitis; central nervous system depression; in animals: cardiac arrhythmias, narcosis		
Target Organs Skin, heart, central nervous system, cardiovascular system		
See also: INTRODUCTION See ICSC CARD: 0050		

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NIOSH Pocket Guide to Chemical Hazards

Chloroform			CAS 67-66-3
CHCl ₃			RTECS FS9100000
Synonyms & Trade Names Methane trichloride, Trichloromethane			DOT ID & Guide 1888 151
Exposure Limits	NIOSH REL: Ca ST 2 ppm (9.78 mg/m ³) [60-minute] See Appendix A		
	OSHA PEL†: C 50 ppm (240 mg/m ³)		
IDLH Ca [500 ppm] See: 67663		Conversion 1 ppm = 4.88 mg/m ³	
Physical Description Colorless liquid with a pleasant odor.			
MW: 119.4	BP: 143°F	FRZ: -82°F	Sol(77°F): 0.5%
VP: 160 mmHg	IP: 11.42 eV		Sp.Gr: 1.48
Fl.P: NA	UEL: NA	LEL: NA	
Noncombustible Liquid			
Incompatibilities & Reactivities Strong caustics; chemically-active metals such as aluminum or magnesium powder, sodium & potassium; strong oxidizers [Note: When heated to decomposition, forms phosgene gas.]			
Measurement Methods NIOSH 1003 See: NMAM or OSHA Methods			
Personal Protection & Sanitation Skin: Prevent skin contact Eyes: Prevent eye contact Wash skin: When contaminated Remove: When wet or contaminated Change: No recommendation Provide: Eyewash, Quick drench		First Aid (See procedures) Eye: Irrigate immediately Skin: Soap wash promptly Breathing: Respiratory support Swallow: Medical attention immediately	
Important additional information about respirator selection Respirator Recommendations NIOSH At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration: (APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode/ (APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus Escape: (APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister/Any appropriate escape-type, self-contained breathing apparatus			
Exposure Routes inhalation, skin absorption, ingestion, skin and/or eye contact			
Symptoms Irritation eyes, skin; dizziness, mental dullness, nausea, confusion; headache, lassitude (weakness, exhaustion); anesthesia; enlarged liver; [potential occupational carcinogen]			
Target Organs Liver, kidneys, heart, eyes, skin, central nervous system			
Cancer Site [in animals: liver & kidney cancer]			
See also: INTRODUCTION See ICSC CARD: 0027 See MEDICAL TESTS: 0047			

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NIOSH Pocket Guide to Chemical Hazards

Toluene		CAS 108-88-3	
C ₆ H ₅ CH ₃		RTECS XS5250000	
Synonyms & Trade Names Methyl benzene, Methyl benzol, Phenyl methane, Toluol		DOT ID & Guide 1294 130	
Exposure Limits	NIOSH REL: TWA 100 ppm (375 mg/m ³) ST 150 ppm (560 mg/m ³)		
	OSHA PEL†: TWA 200 ppm C 300 ppm 500 ppm (10-minute maximum peak)		
IDLH 500 ppm See: 108883		Conversion 1 ppm = 3.77 mg/m ³	
Physical Description Colorless liquid with a sweet, pungent, benzene-like odor.			
MW: 92.1	BP: 232°F	FRZ: -139°F	Sol(74°F): 0.07%
VP: 21 mmHg	IP: 8.82 eV		Sp.Gr: 0.87
FLP: 40°F	UEL: 7.1%	LEL: 1.1%	
Class IB Flammable Liquid: FLP. below 73°F and BP at or above 100°F.			
Incompatibilities & Reactivities Strong oxidizers			
Measurement Methods NIOSH 1500, 1501, 3800, 4000; OSHA 111 See: NMAM or OSHA Methods			
Personal Protection & Sanitation Skin: Prevent skin contact Eyes: Prevent eye contact Wash skin: When contaminated Remove: When wet (flammable) Change: No recommendation		First Aid (See procedures) Eye: Irrigate immediately Skin: Soap wash promptly Breathing: Respiratory support Swallow: Medical attention immediately	
Important additional information about respirator selection Respirator Recommendations NIOSH Up to 500 ppm: (APF = 10) Any chemical cartridge respirator with organic vapor cartridge(s)/(APF = 25) Any powered, air-purifying respirator with organic vapor cartridge(s)/(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister/(APF = 10) Any supplied-air respirator/(APF = 50) Any self-contained breathing apparatus with a full facepiece Emergency or planned entry into unknown concentrations or IDLH conditions: (APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode/(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus Escape: (APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister/Any appropriate escape-type, self-contained breathing apparatus			
Exposure Routes inhalation, skin absorption, ingestion, skin and/or eye contact			
Symptoms Irritation eyes, nose; lassitude (weakness, exhaustion), confusion, euphoria, dizziness, headache; dilated pupils, lacrimation (discharge of tears); anxiety, muscle fatigue, insomnia; paresthesia; dermatitis; liver, kidney damage			
Target Organs Eyes, skin, respiratory system, central nervous system, liver, kidneys			
See also: INTRODUCTION See ICSC CARD: 0078 See MEDICAL TESTS: 0232			

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NIOSH Pocket Guide to Chemical Hazards

Methyl chloroform		CAS 71-55-6
CH_3CCl_3		RTECS KJ2975000
Synonyms & Trade Names Chloroethene; 1,1,1-Trichloroethane; 1,1,1-Trichloroethane (stabilized)		DOT ID & Guide 2831 160
Exposure Limits	NIOSH REL: C 350 ppm (1900 mg/m ³) [15-minute] See Appendix C (Chloroethanes)	
	OSHA PEL†: TWA 350 ppm (1900 mg/m ³)	
IDLH 700 ppm See: 71556		Conversion 1 ppm = 5.46 mg/m ³
Physical Description Colorless liquid with a mild, chloroform-like odor.		
MW: 133.4	BP: 165°F	FRZ: -23°F
VP: 100 mmHg	IP: 11.00 eV	Sp.Gr: 1.34
F.I.P: ?	UEL: 12.5%	LEL: 7.5%
Combustible Liquid, but burns with difficulty.		
Incompatibilities & Reactivities Strong caustics; strong oxidizers; chemically-active metals such as zinc, aluminum, magnesium powders, sodium & potassium; water [Note: Reacts slowly with water to form hydrochloric acid.]		
Measurement Methods NIOSH 1003 See: NMAM or OSHA Methods		
Personal Protection & Sanitation Skin: Prevent skin contact Eyes: Prevent eye contact Wash skin: When contaminated Remove: When wet or contaminated Change: No recommendation		First Aid (See procedures) Eye: Irrigate immediately Skin: Soap wash promptly Breathing: Respiratory support Swallow: Medical attention immediately
Important additional information about respirator selection Respirator Recommendations NIOSH/OSHA Up to 700 ppm: (APF = 10) Any supplied-air respirator*/(APF = 50) Any self-contained breathing apparatus with a full facepiece Emergency or planned entry into unknown concentrations or IDLH conditions: (APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode/(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus Escape: (APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister/Any appropriate escape-type, self-contained breathing apparatus		
Exposure Routes inhalation, ingestion, skin and/or eye contact		
Symptoms Irritation eyes, skin; headache, lassitude (weakness, exhaustion), central nervous system depression, poor equilibrium; dermatitis; cardiac arrhythmias; liver damage		
Target Organs Eyes, skin, central nervous system, cardiovascular system, liver		
See also: INTRODUCTION See ICSC CARD: 0079 See MEDICAL TESTS: 0141		

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NIOSH Pocket Guide to Chemical Hazards

Chromium(III) compounds (as Cr)		CAS	
		RTECS	
Synonyms & Trade Names Synonyms vary depending upon the specific Chromium(III) compound. [Note: Chromium(III) compounds include soluble chromic salts.]		DOT ID & Guide	
Exposure Limits	NIOSH REL: TWA 0.5 mg/m ³ See Appendix C		
	OSHA PEL: TWA 0.5 mg/m ³ See Appendix C		
IDLH 25 mg/m ³ [as Cr(III)] See: cr3m3		Conversion	
Physical Description Appearance and odor vary depending upon the specific compound.			
Properties vary depending upon the specific compound.			
Incompatibilities & Reactivities Varies			
Measurement Methods NIOSH 7024; OSHA ID121, ID125G See: NMAM or OSHA Methods			
Personal Protection & Sanitation Skin: Prevent skin contact Eyes: Prevent eye contact Wash skin: When contaminated Remove: When wet or contaminated Change: No recommendation		First Aid (See procedures) Eye: Irrigate immediately Skin: Water flush promptly Breathing: Respiratory support Swallow: Medical attention immediately	
Important additional information about respirator selection Respirator Recommendations NIOSH/OSHA Up to 2.5 mg/m³: (APF = 5) Any dust and mist respirator* Up to 5 mg/m³: (APF = 10) Any dust and mist respirator except single-use and quarter-mask respirators*/(APF = 10) Any supplied-air respirator* Up to 12.5 mg/m³: (APF = 25) Any supplied-air respirator operated in a continuous-flow mode*/(APF = 25) Any powered, air-purifying respirator with a dust and mist filter* Up to 25 mg/m³: (APF = 50) Any air-purifying, full-facepiece respirator with a high-efficiency particulate filter/(APF = 50) Any powered, air-purifying respirator with a tight-fitting facepiece and a high-efficiency particulate filter*/(APF = 50) Any self-contained breathing apparatus with a full facepiece/(APF = 50) Any supplied-air respirator with a full facepiece Emergency or planned entry into unknown concentrations or IDLH conditions: (APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode/(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus Escape: (APF = 50) Any air-purifying, full-facepiece respirator with a high-efficiency particulate filter/Any appropriate escape-type, self-contained breathing apparatus			
Exposure Routes inhalation, ingestion, skin and/or eye contact			
Symptoms Irritation eyes; sensitization dermatitis			
Target Organs Eyes, skin			
See also: INTRODUCTION See MEDICAL TESTS: 0052			

NIOSH Pocket Guide to Chemical Hazards

Chromic acid and chromates		CAS 1333-82-0 (CrO ₃)
CrO ₃ (acid)		RTECS GB6650000 (CrO ₃)
Synonyms & Trade Names Chromic acid (CrO ₃): Chromic anhydride, Chromic oxide, Chromium(VI) oxide (1:3), Chromium trioxide Synonyms of chromates (i.e., chromium(VI) compounds) such as zinc chromate vary depending upon the specific compound.		DOT ID & Guide 1755 154 (acid solution) 1463 141 (acid, solid)
Exposure Limits	NIOSH REL (as Cr): Ca TWA 0.001 mg/m ³ See Appendix A See Appendix C	
	OSHA PEL (as CrO ₃): C 0.1 mg/m ³ See Appendix C	
IDLH Ca [15 mg/m ³ {as Cr(VI)}] See: 1333820		Conversion
Physical Description CrO ₃ : Dark-red, odorless flakes or powder. [Note: Often used in an aqueous solution (H ₂ CrO ₄).]		
MW: 100.0	BP: 482°F (Decomposes)	MLT: 387°F (Decomposes)
VP: Very low	IP: NA	Sp.Gr: 2.70 (CrO ₃)
F.P: NA	UEL: NA	LEL: NA
CrO ₃ : Noncombustible Solid, but will accelerate the burning of combustible materials.		
Incompatibilities & Reactivities Combustible, organic, or other readily oxidizable materials (paper, wood, sulfur, aluminum, plastics, etc.); corrosive to metals		
Measurement Methods NIOSH 7600, 7604, 7703, 9101; OSHA ID103, ID215, W4001 See: NMAM or OSHA Methods		
Personal Protection & Sanitation Skin: Prevent skin contact Eyes: Prevent eye contact Wash skin: When contaminated Remove: When wet or contaminated Change: Daily Provide: Eyewash, Quick drench		First Aid (See procedures) Eye: Irrigate immediately Skin: Soap flush immediately Breathing: Respiratory support Swallow: Medical attention immediately
Important additional information about respirator selection Respirator Recommendations NIOSH At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration: (APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode/ (APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus Escape: (APF = 50) Any air-purifying, full-facepiece respirator with a high-efficiency particulate filter/Any appropriate escape-type, self-contained breathing apparatus		
Exposure Routes inhalation, ingestion, skin and/or eye contact		
Symptoms Irritation respiratory system; nasal septum perforation; liver, kidney damage; leukocytosis (increased blood leukocytes), leukopenia (reduced blood leukocytes), eosinophilia; eye injury, conjunctivitis; skin ulcer, sensitization dermatitis; [potential occupational carcinogen]		
Target Organs Blood, respiratory system, liver, kidneys, eyes, skin		
Cancer Site [lung cancer]		
See also: INTRODUCTION See ICSC CARD: 1194 See MEDICAL TESTS: 0051		

**Chromic Acid and Chromates (as CrO_3),
chromium(II) and Chromium(III) Compounds
(as Cr), and Chromium Metal (as Cr)**

The NIOSH REL (10-hour TWA) is $0.001 \text{ mg Cr(VI)}/\text{m}^3$ for all hexavalent chromium [Cr(VI)] compounds. NIOSH considers all Cr(VI) compounds (including chromic acid, tert-butyl chromate, zinc chromate, and chromyl chloride) to be potential occupational carcinogens.

The NIOSH REL (8-hour TWA) is $0.5 \text{ mg Cr}/\text{m}^3$ for chromium metal and chromium(II) and chromium(III) compounds.

The OSHA PEL is $0.1 \text{ mg CrO}_3/\text{m}^3$ (ceiling) for chromic acid and chromates (including tert-butyl chromate with a "skin" designation and zinc chromate); $0.5 \text{ mg Cr}/\text{m}^3$ (8-hour TWA) for chromium(II) and chromium(III) compounds; and $1 \text{ mg Cr}/\text{m}^3$ (8-hour TWA) for chromium metal and insoluble salts.

International Chemical Safety Cards

METHANE
ICSC: 0291


Methyl hydride
CH₄

Molecular mass: 16.0
(cylinder)


ICSC # 0291
CAS # 74-82-8
RTECS # PA1490000
UN # 1971
EC # 601-001-00-4

October 02, 2000 Peer reviewed

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Extremely flammable.	NO open flames, NO sparks, and NO smoking.	Shut off supply; if not possible and no risk to surroundings, let the fire burn itself out; in other cases extinguish with water spray, powder, carbon dioxide.
EXPLOSION	Gas/air mixtures are explosive.	Closed system, ventilation, explosion-proof electrical equipment and lighting. Use non-sparking handtools.	In case of fire: keep cylinder cool by spraying with water. Combat fire from a sheltered position.
EXPOSURE			
•INHALATION	Suffocation. See Notes.	Ventilation. Breathing protection if high concentration.	Fresh air, rest. Artificial respiration if indicated. Refer for medical attention.
•SKIN	ON CONTACT WITH LIQUID: FROSTBITE.	Cold-insulating gloves.	ON FROSTBITE: rinse with plenty of water, do NOT remove clothes. Refer for medical attention.
•EYES	ON CONTACT WITH LIQUID: FROSTBITE.	Safety goggles.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
•INGESTION			
SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING	
Evacuate danger area! Consult an expert! Ventilation. Remove all ignition sources. (Extra personal	Fireproof. Cool. Ventilation along the floor and ceiling.	F+ symbol R: 12	

protection: self-contained breathing apparatus). NEVER direct water jet on liquid.

S: 2-9-16-33
UN Hazard Class: 2.1

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0291

Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities (C) IPCS CEC 1994. No modifications to the International version have been made except to add the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

International Chemical Safety Cards

METHANE

ICSC: 0291

I M P O R T A N T D A T A	<p>PHYSICAL STATE; APPEARANCE: COLOURLESS, COMPRESSED OR LIQUEFIED GAS , WITH NO ODOUR.</p> <p>PHYSICAL DANGERS: The gas is lighter than air.</p> <p>CHEMICAL DANGERS:</p> <p>OCCUPATIONAL EXPOSURE LIMITS: TLV: simple asphyxiant (ACGIH 2000). MAK not established.</p>	<p>ROUTES OF EXPOSURE: The substance can be absorbed into the body by inhalation.</p> <p>INHALATION RISK: On loss of containment this gas can cause suffocation by lowering the oxygen content of the air in confined areas.</p> <p>EFFECTS OF SHORT-TERM EXPOSURE: Rapid evaporation of the liquid may cause frostbite.</p> <p>EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:</p>
PHYSICAL PROPERTIES	Boiling point: -161°C Melting point: -183°C Solubility in water, ml/100 ml at 20°C: 3.3 Relative vapour density (air = 1): 0.6	Flash point: Flammable Gas Auto-ignition temperature: 537°C Explosive limits, vol% in air: 5-15 Octanol/water partition coefficient as log Pow: 1.09
ENVIRONMENTAL DATA		
NOTES		
Density of the liquid at boiling point: 0.42 kg/l. High concentrations in the air cause a deficiency of oxygen with the risk of unconsciousness or death. Check oxygen content before entering area. Turn leaking cylinder with the leak up to prevent escape of gas in liquid state. After use for welding, turn valve off; regularly check tubing, etc., and test for leaks with soap and water. The measures mentioned in section PREVENTION are applicable to production, filling of cylinders, and storage of the gas. Other UN number: 1972 (refridgerated liquid), Hazard class: 2.1.		
Transport Emergency Card: TEC (R)-refridgerated liquid 622-1; LPG 622-2; 20G04 NFPA Code: H 1; F 4; R 0;		

ADDITIONAL INFORMATION

ICSC: 0291

METHANE

(C) IPCS, CEC, 1994

**IMPORTANT
LEGAL
NOTICE:**

Neither NIOSH, the CEC or the IPCS nor any person acting on behalf of NIOSH, the CEC or the IPCS is responsible for the use which might be made of this information. This card contains the collective views of the IPCS Peer Review Committee and may not reflect in all cases all the detailed requirements included in national legislation on the subject. The user should verify compliance of the cards with the relevant legislation in the country of use. The only modifications made to produce the U.S. version is inclusion of the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

NIOSH Pocket Guide to Chemical Hazards

Hydrogen sulfide		CAS 7783-06-4	
H ₂ S		RTECS MX1225000	
Synonyms & Trade Names Hydrosulfuric acid, Sewer gas, Sulfuretted hydrogen		DOT ID & Guide 1053 117	
Exposure Limits	NIOSH REL: C 10 ppm (15 mg/m ³) [10-minute]		
	OSHA PEL†: C 20 ppm 50 ppm [10-minute maximum peak]		
IDLH 100 ppm		Conversion 1 ppm = 1.40 mg/m ³	
Physical Description Colorless gas with a strong odor of rotten eggs. [Note: Sense of smell becomes rapidly fatigued & can NOT be relied upon to warn of the continuous presence of H ₂ S. Shipped as a liquefied compressed gas.]			
MW: 34.1	BP: -77°F	FRZ: -122°F	Sol: 0.4%
VP: 17.6 atm	IP: 10.46 eV	RGasD: 1.19	
Fl.P: NA (Gas)	UEL: 44.0%	LEL: 4.0%	
Flammable Gas			
Incompatibilities & Reactivities Strong oxidizers, strong nitric acid, metals			
Measurement Methods NIOSH 6013; OSHA ID141			
Personal Protection & Sanitation Skin: Frostbite Eyes: Frostbite Wash skin: No recommendation Remove: When wet (flammable) Change: No recommendation Provide: Frostbite		First Aid (See procedures) Eye: Frostbite Skin: Frostbite Breathing: Respiratory support	
Respirator Recommendations NIOSH Up to 100 ppm: (APF = 25) Any powered, air-purifying respirator with cartridge(s) providing protection against the compound of concern/(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted canister providing protection against the compound of concern/(APF = 10) Any supplied-air respirator*/(APF = 50) Any self-contained breathing apparatus with a full facepiece Emergency or planned entry into unknown concentrations or IDLH conditions: (APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode/(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus Escape: (APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or			

back-mounted canister providing protection against the compound of concern/Any appropriate escape-type, self-contained breathing apparatus

Exposure Routes inhalation, skin and/or eye contact

Symptoms Irritation eyes, respiratory system; apnea, coma, convulsions; conjunctivitis, eye pain, lacrimation (discharge of tears), photophobia (abnormal visual intolerance to light), corneal vesiculation; dizziness, headache, lassitude (weakness, exhaustion), irritability, insomnia; gastrointestinal disturbance; liquid: frostbite

Target Organs Eyes, respiratory system, central nervous system

See also: INTRODUCTION